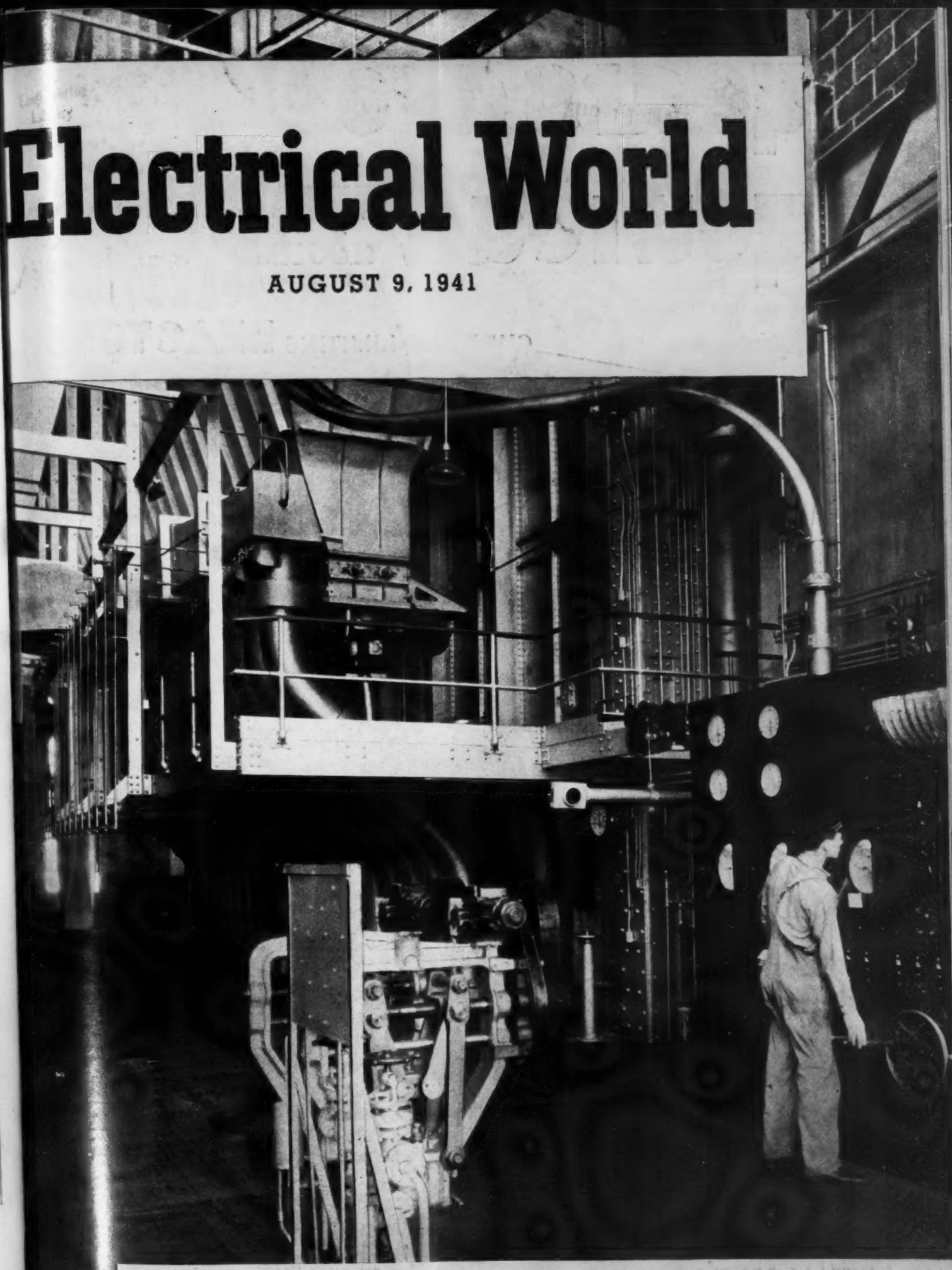
Electrical World

AUGUST 9, 1941



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Vol. 87, No. 24
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August 9, 1941

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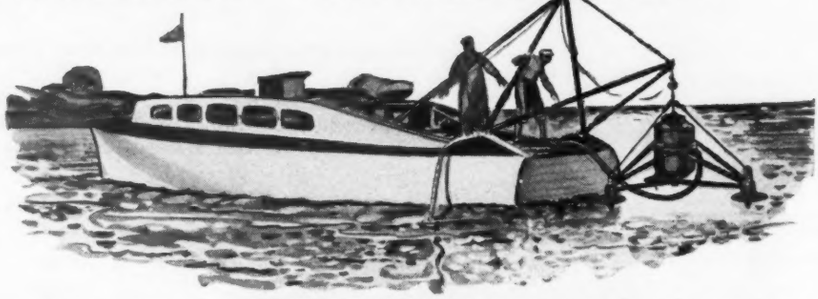

Exact gravity measurements to help locate oil deposits can be made at depths of several hundred feet below water by means of this underwater gravimeter, developed by the engineers of Gulf Research and Development Company.

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Different

When the little brown rooster took the little brown hen up to see the ostrich egg all he was thinking of was the inspiration that should come from example. He was very much like those who would inspire the electric utilities to do a real job of public education by holding up the results obtained by the Bell Telephone System. The reasoning is simple—if a telephone utility can get public understanding and weather all kinds of attack, why can't a power utility do likewise?

We have no sympathy with those who cannot benefit by example on the grounds that the conditions are different, or the area served is different. That has always been a handy alibi for people well pleased with the way they were doing things, for people too lazy to try new things, or for people who think nothing is any good that they don't themselves initiate. Nevertheless, in this particular instance it is no more fair to hold up the telephone example to the electric utilities than it was to try to stimulate the little brown hen with the ostrich egg.

The Bell Telephone Companies are unified in public policy; the electric utilities are not only not unified, but sometimes appear to have no desire to be. A good telephone policy in a town in Michigan is a good policy in a town in Florida. This isn't so in the electric utility business. Moreover, being a unified industry it does things as an industry. The electric utilities seldom do things as an industry. They do things as single companies. They do things locally. And for that reason the industry has no national personality.

This was borne forcibly upon us when we tried to find for a national publicity program the contributions of electric utilities to defense. There were plenty of examples, but they were all local contributions. The telephone people can do a real job at some Southern camp and all the telephone people can bask in the glory of that accomplishment. A power company can do an especially find job for defense, but it alone can take credit, none of it can be reflected to other companies.

The only point to this discussion is that electric utilities are considering a national campaign and had progressed far enough to invite suggestions from a national agency. There is a job to be done, but it is not the same job as the telephone activity. The approach must be different.

Great difficulty is going to be experienced because there is no unified national public policy and because the localized aspect of the business doesn't lend itself to particularization or case material. The greater difficulty, however, will come from something the telephone people don't have to worry about—agreement. Rugged individualism is all right in its place, but there are times when to go along with the pack is the only way to get anywhere.

But just because electric utilities are different is no reason why a national campaign of public education cannot be undertaken successfully. If the industry will leave the technique to professionals and for once decide to find reasons why the suggested campaign should be undertaken rather than reasons why it shouldn't, it is highly probable that a lot of good can be accomplished.

Bangor Hydro Modernizes Plants

Increased capacity obtained by improving the existing facilities and by adding new units — Transmission also developed for larger service

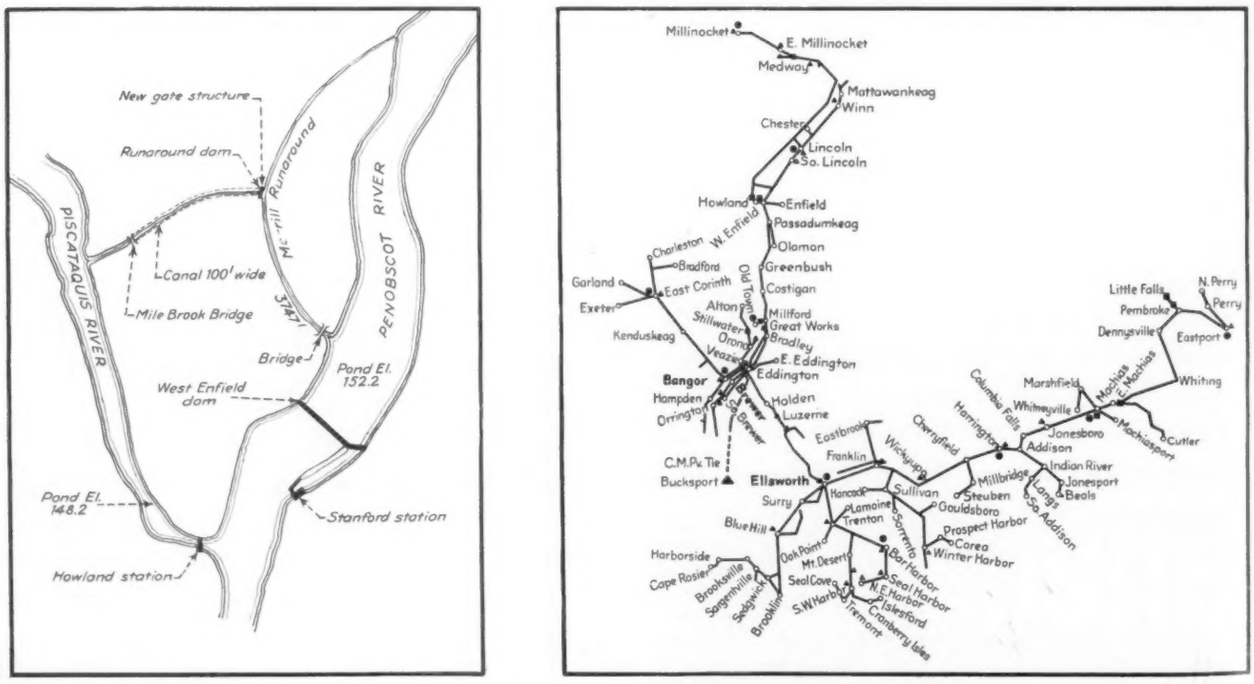
PAUL F. KRUSE,* Bangor (Me.) Hydro-Electric Company

WITH its own sources of energy entirely water power produced in twelve generating stations having a combined capacity under normal water and head conditions of about 33,500 kw., the Bangor Hydro-Electric Company is in a most unusual position among United States public utilities. Electrically speaking, we are about one one-thousandth part of the country. Our trends of growth, however, during the past decade have paralleled those of the United States in general, and our average use of electricity by domestic and small power customers has approximated that of the country as a whole. The utilization of these plants in upper Maine, extending as our system does from the Eastport district along the coast through the Mt. Desert region to Bangor, and thence along the Penobscot Valley to Millinocket, involves close engineering study of their designs and operations both in relation to present and prospective loads and to economical use of hydro.

About five years ago it became apparent to President Edward M. Graham that within a short time it would be necessary to expand our generating facilities. An investigation of new sources of power was made by our engineering forces. Preliminary plans and comparative cost estimates were made for several undeveloped water-power sites, different types of fuel-burning plants and extensions to existing developments. These studies showed conclusively that a program of modernization and expansion of existing plants and transmission facilities would provide the most economical increased production consistent with our load growth.

The first step in this program took place at Howland station, on the Piscataquis River, at its junction with the Penobscot. This plant, with a total installed capacity of 1,875 kw., was erratic in its output and non-dependable due to the extremes of flow in the Piscataquis. In contrast, our Stanford station, at the West Enfield dam on the Penobscot about ½ mile above the river junction, was developed with generating capacity equivalent only to about the low flow of the Penobscot, which is regulated in part

*Chief engineer.



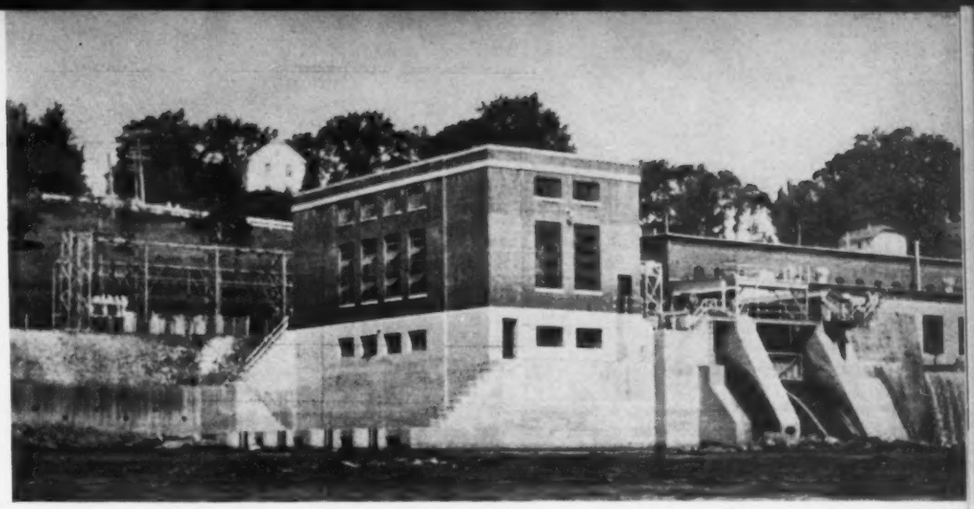
PLAN of Howland Runaround from Penobscot to Piscataquis River (left). Lines and plants of Bangor company (right)

by storage on the west branch of that river.

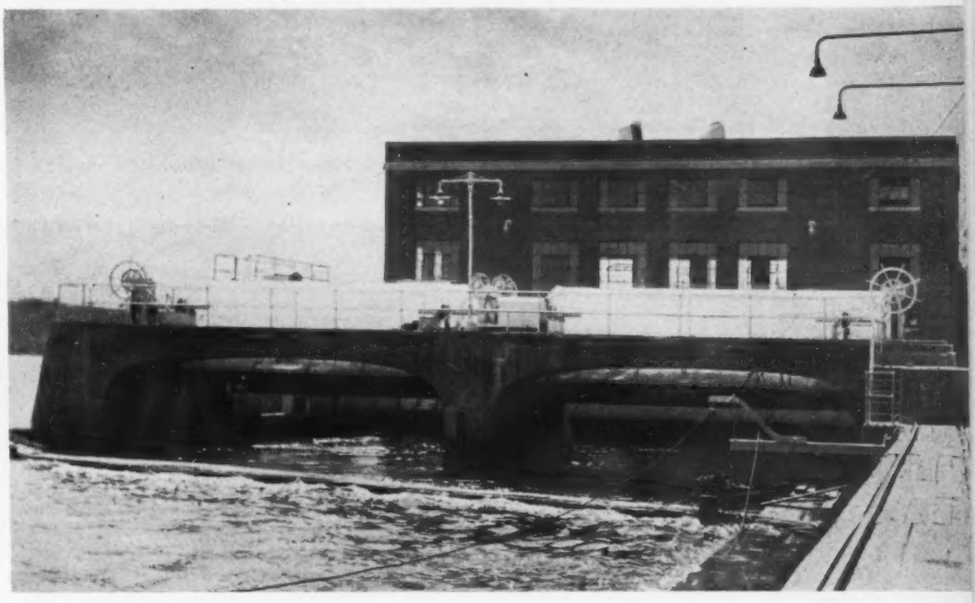
We therefore had a situation in which there was a serious deficiency in the flow in the Piscataquis during low water periods, necessitating at times the complete shutdown of the Howland station, and, on the other hand, excess water available nearly 100 percent of the time in the Penobscot within a mile of the Howland plant.

Diversion Returned

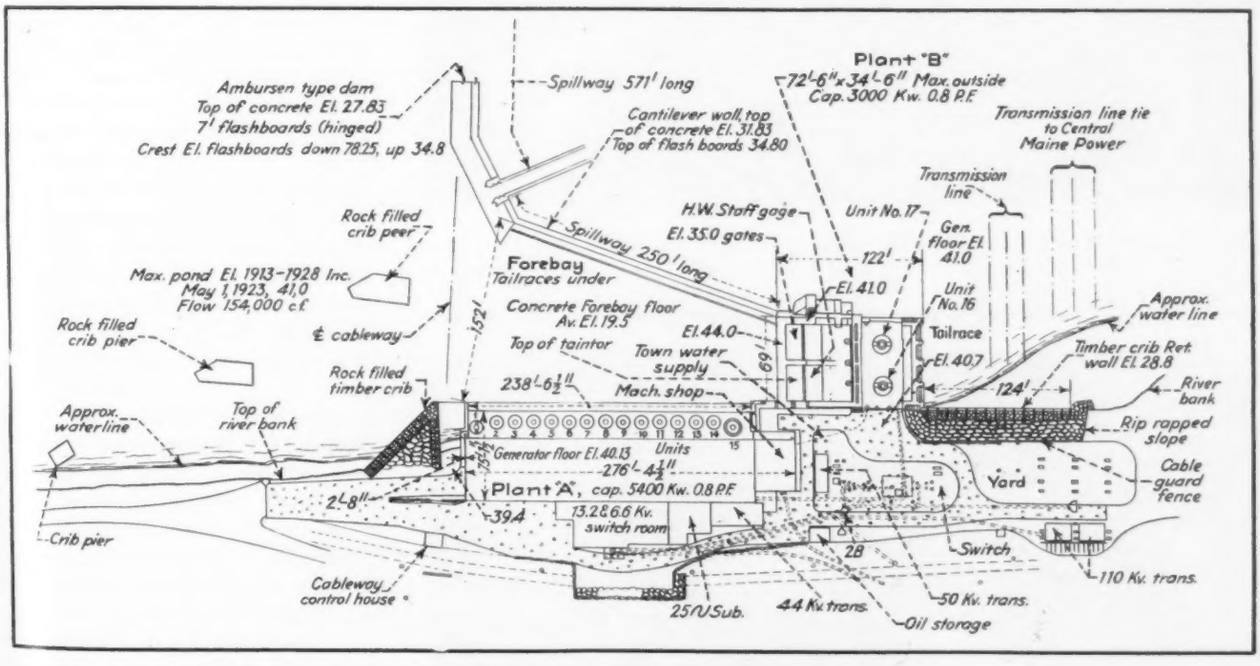
In earlier years a small dike known as the "Runaround Dam" had been built at the head of a small stream known as Mile Brook. When the West Enfield dam was built this brook formed a connecting water course between the two rivers above the West Enfield and Howland dams. Under normal water conditions the difference in pond level between the two dams is 4 ft. "Runaround Dam" was built and provided with four gates for water control. A canal about ¾ mile long was excavated between this dam and the Piscataquis River along the course of Mile Brook. The gate structure and canal have a discharge capacity, under the normal 4-ft. head, of about 800 c.f.s., which is about half the water capacity of the Howland plant. After leaving Howland station the water returns to the Penobscot. The effect of this diversion of excess water has been to give us the



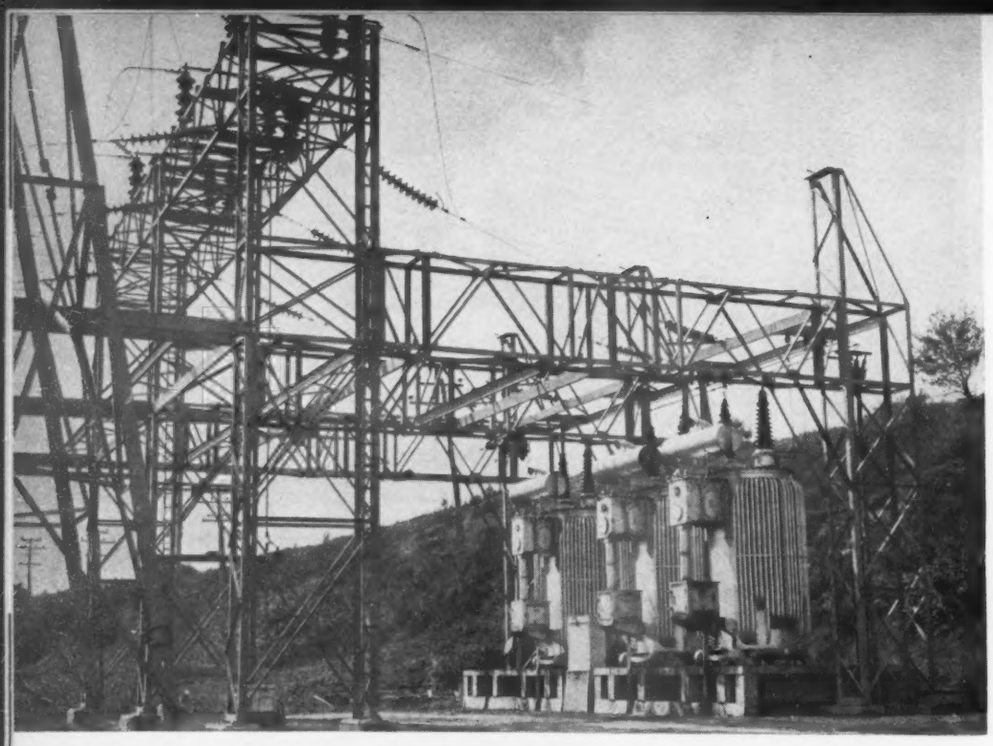
VEAZIE development, new structure in foreground



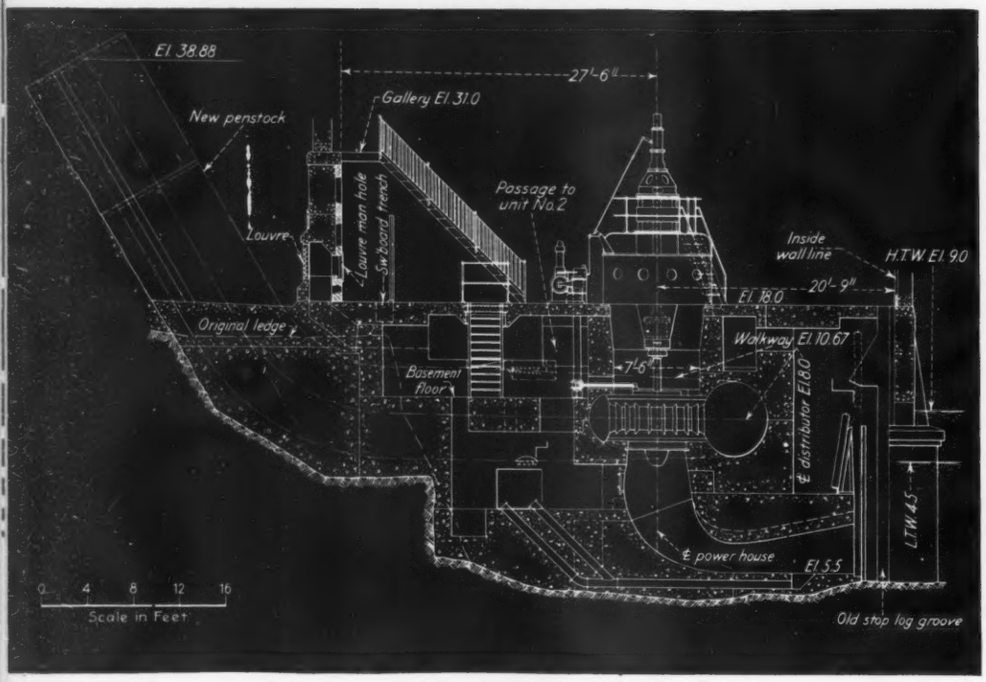
FOREBAY above Veazie extension



PLAN of Veazie hydro-electric plant, showing older station, new development and switchyard

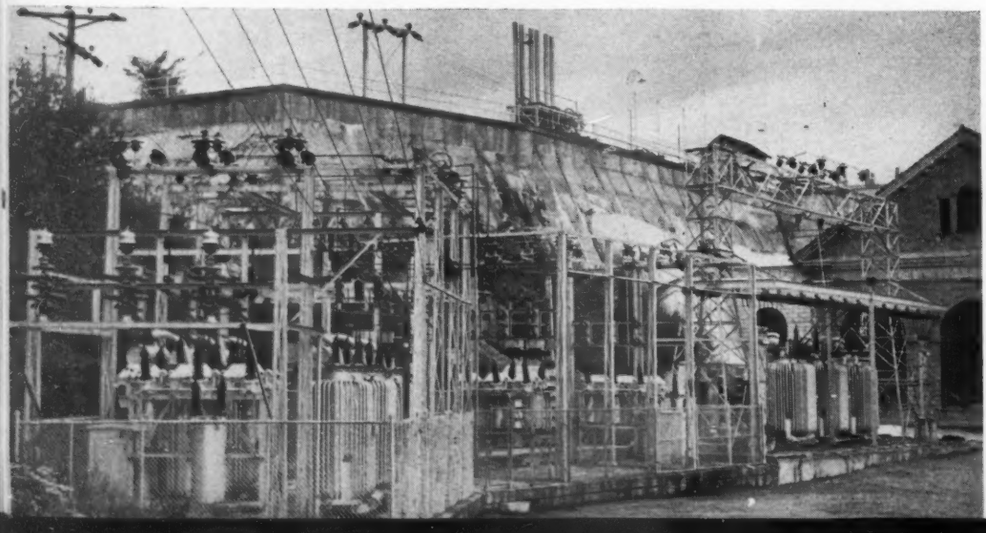


SWITCHYARD at Veazie showing 110-kv. tie-in with Central Maine Power Co.



CROSS-SECTION of new vertical units at Ellsworth station

CLOSE-UP of Ellsworth switchyard below dam and in front of station



equivalent of a large storage reservoir in making possible a flow at all times at Howland in excess of 50 percent of its capacity.

A second and major step in our program took place at our Veazie and Ellsworth stations. Before this Veazie (about 5 miles from our Bangor load center), with fifteen small generating units, had a capacity of about 5,500 kw. under a normal head of 17 ft. and a water utilization capacity corresponding to a river flow available 80 percent of the time. Ellsworth, our peak load and standby plant on the Union River about 25 miles east of Bangor, formerly had four generating units with a combined rating of about 7,200 kw. These plants form the backbone of our generating system and our program provided for an extension with two new units at Veazie, modernization and expansion at Ellsworth, where two new vertical units replaced two old horizontals. Improvements in our transmission facilities also formed a part of this undertaking.

Concrete Aggregates

The new station at Veazie, on the Penobscot above Bangor, contains two 1,875-kva. G.E. generators direct-driven by S. Morgan Smith waterwheels. The extension is 72 ft. 6 in. x 34 ft. 6 in. outside, of concrete, brick and steel construction, and fireproof throughout. It is located at the lower end of the forebay and is equipped with two taintor gates for unwatering the new plant. Ice and trash gates provided in the outer wall of the forebay are electrically heated. The operating head is 17 ft. and the turbines are of the fixed blade propeller type, running at 128.6 r.p.m. The new units generate at 6.9 kv. and are directly connected through underground cables to the 6.9 kv. bus in the old station. The extension is automatic in operation to the extent that it is directly controlled from the switchboard in the older section of the plant.

A problem of obtaining the proper sand for concrete aggregates required some attention during the construction of this extension. A crushed and graded stone which was washed was located nearby and tested satisfactory. Tests were made at the University of Maine on four sands from different pits, one of which was a washed sand from the same source as the stone.

[*Continued on page 130*]

Utility Priorities

Procedures for securing materials and supplies for new generating plant, additions and extensions, maintenance and repairs, emergency breakdowns and appliances and repair parts

GEORGE E. DOYING, Jr., Washington Staff

GETTING materials and supplies to those who are directly engaged in making planes and guns and tanks is only a part of the job which priorities must do. As there are industries not directly turning out equipment for the government, but essential to the production of such materials or to the civilian life, it becomes necessary to make provision in the priorities system to see that these, too, in so far as possible, are assured raw materials. This is the phase of priorities into which utilities, for the most part, fit.

Critical List

The priorities system, in the beginning, was a method used by the Army and Navy to schedule their deliveries, both in relation to non-military orders and in relation to each other. In this brief stage priorities served more as a time-table than as an allocation function. Scheduling of deliveries is still a fundamental function of this system, but now it insures also that scarce materials will be available to those which defense dictates need them. Army-Navy preference ratings, now issued under delegated authority of the OPM Priorities Division, still represent the bulk of priorities. All military orders for some 300 items (including practically everything used for utility equipment) on the so-called Critical List automatically are given ratings.

As shortages of particular materials grew more acute, and as the need developed for scheduling deliveries to other contractors doing jobs related to armament production, the priorities machinery necessarily had to be implemented and expanded. Several different types of priorities have been promulgated to meet particular situations. This evolution is still going on and utilities may expect considerable tailoring of the system for their needs before long.

Individual Priorities

For utilities there are now three procedures which can be used in applicable cases to obtain priorities for those materials which cannot be purchased through the usual channels of commerce. Individual preference certificates, still the heart of the priorities system, apply to specific orders and separate certificates must be obtained for each order—a great number might be needed, for example, to complete the installation of a generator unit, or to construct a transmission line.

If these individual priorities are required on a project being carried out directly for defense—a transmission line to any Army camp is an example—application should be made to the construction quartermaster in charge. In all other cases, to obtain such a priority, it is necessary to fill out Form PD-1, available at all Federal Reserve banks, and submit it to J. A. Krug, OPM's Coordinator for Defense Power, or to the priorities staff men in this unit, John C. Parker and Frederick Schaff.

Project Rating

Another form of priority available to utilities, newer and much more sparingly issued at present, is the project rating. Given this rating on, say, a power plant or transmission line, a utility is able to obtain preference from its suppliers on deliveries of all specified materials needed to finish the project. Suppliers, in turn, may pass along this rating to their suppliers to obtain needed sub-assemblies and raw materials to fill the orders.

At present Priorities Division discourages efforts to obtain this project rating; it is being issued only in a comparatively few instances where projects are directly related and vital to the armament effort. Messrs. Krug, Parker and Schaff, however, hope that in the evolution of the system this will soon be changed so that all power expansion projects will have a blanket set of priority ratings, assuring not only necessary materials but maximum scheduled production. They hope also to arrange the same treatment for transmission line construction necessary to pool power resources for defense loads.

Repair and Maintenance

These two types of priorities—individual certificates and project ratings—apply to new construction. A third form is being set up to cover the day-to-day maintenance and repair problems. Promulgated by the Office of Price Administration and Civilian Supply (OPACS), in its role as protector of civilian life, the job of administering the necessary priorities to keep these materials flowing belongs to OPM.

Repair and maintenance orders, under this program, will probably be given an A-10 rating by OPM, the lowest of rankings classified as a defense rating. Emergency breakdown

repairs will have a much higher preference, probably the top general classification of all, A-1-a. Utilities will be able to apply to OPM for this rating as soon as the formal machinery is set up. The rating will be a blanket one, good until revoked. In the first instance utilities will serve copies of their certificate on their suppliers directing them to catalogue the orders as A-10. Thereafter, subsequent orders will refer to the serial number of the certificate.

Definition of Use

Issuance of the blanket repair and maintenance rating will probably provide for regular reports to OPM on its use—a listing of all orders for materials to which the rating has been assigned. OPM will require that this rating not be used to increase inventory beyond a historical and normal operating level, but provision will be made for a utility to make normal repairs from inventory and subsequently replace the items through use of the rating. Definitions for use of this rating also will strictly limit its use to actual repair and maintenance of existing equipment and prohibit its use as a means of putting in more efficient installations. Availability of the A-1-a rating for emergency breakdown repairs will be limited to instances of major disasters such as floods, storms or burning out a generator, and then to be accompanied by telegraphic report to OPM.

These are the avenues open to utilities for procuring the things necessary to continue and to expand operations in this war emergency. Within their limitations they also are available to the suppliers of utilities, as well as others. For manufacturers, as for utilities, the individual priority certificate obtained through filling out Form PD-1 is still the best approach in most instances, when individual supply problems are involved.

Defense Supplies Rating

In addition, there is the Defense Supplies Rating Plan, available now to some manufacturers and suppliers of utility materials and certain to become available to many more as the repair and maintenance priority system gets into full operation. This plan is designed to meet the problem of the manufacturers who, because they must start production in advance of receiving orders, need aid to secure a steady flow of materials into their plants. It provides for an A-10 rating for that portion of the regular requirements of raw materials which they can clearly show is to be used to fill orders having priority ratings, or otherwise identified as defense. Particularly as the repair and maintenance programs become operative, utility suppliers will be accumulating orders with A-10 ratings which they can classify as defense orders to qualify for the Defense Supplies Rating Plan. Application for this rating should be made to L. J. Martin of OPM's Priorities Division, with a detailed outline of operations.

Effective, too, for getting supplies of most metals is to get on the shipping lists of the producers. Practically all metals are subject to some degree of priorities control over allocation, but except where the supply is no greater than orders with "A" ratings, such as magnesium and synthetic rubber, shipments are still made to regular customers. Among raw materials subject to allocation control, steel is in a special category. This special arrangement provides that where a customer cannot place an order satisfactorily he should get in touch with Priorities Division (using form PD-1 or form PD-32), which will require the supplier to explain the delay or rejection.

Extensions

As can be seen from the foregoing discussion, the evolution of priorities now covers expansion of facilities which can be shown to have a defense relationship and necessary repair and maintenance to maintain uninterrupted service both of defense and civilian load. This leaves unprovided for materials necessary for ordinary extensions of service to new territory or new homes. These are, of course, growing. Edison Electric Institute is taking up this matter with OPACS officials and probably will discuss it also with the proper authorities in OPM. Probable result will be promulgation of some system similar in operation to that for repair and maintenance, although doubtless carrying a lower rating, but this may not develop for some time. Placement of orders for future delivery, in advance of actual need through regular suppliers probably will pay the best dividends.

Turning from the operating to the appliance field, the picture becomes considerably clouded. There are two apparent reasons: First, caring for operations was a more pressing problem, and, second, overlapping jurisdiction of OPACS and OPM has confused and perhaps delayed formation of policies.

Presidential untangling of the activities of these two co-equal defense agencies is generally anticipated in Washington and may have been attempted by the time this is printed. As things stand presently, OPACS has held conferences with representatives of all major appliance industries to exchange data on materials requirements and supplies. This agency also has proposed tentative curtailments of appliance output in several lines.

If, however, OPM allows greater quantities of raw materials to reach these manufacturers than the OPACS schedules call for or the manufacturers develop substitute materials, while at the same time OPM doesn't load up their factories with armament work, it is difficult to see how the curtailment schedules will occur. OPM has an electrical manufacturers' industry committee which is working on these same problems.

Repair Parts

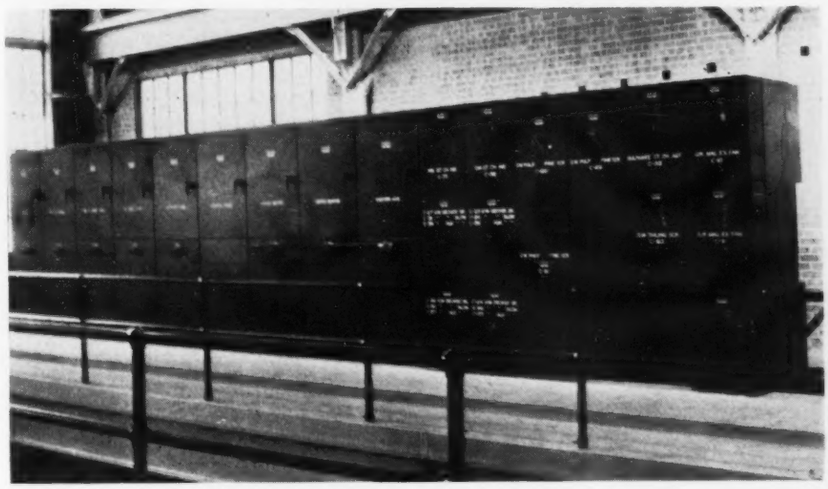
One other OPACS action needs to be reported here. That agency has issued a directive for setting up priority machinery to insure raw materials supplies for manufacture of repair and maintenance parts for household appliances now in use. This would be similar to the repair and maintenance program being established for essential public services. Priorities Division has yet to implement this household maintenance program with any kind of machinery or rating, but this doubtless will be done eventually.

One thing is certain, the supply of usual raw materials for appliance manufacturers will be increasingly reduced, and prevailing official policy is to cut down on production of consumers' durable goods—both as a restraint on consumer purchasing and to free manufacturing capacity and skills for conversion into armament production channels. This means that there will be less unit output in the appliance field; it's how much less that is conflicting.

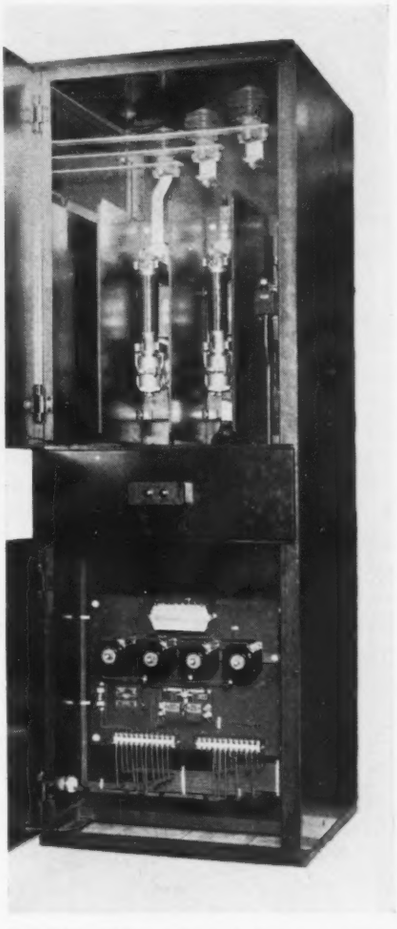
Fuse-Contactor Combination Controls High Voltage

Motor control for Texas paper mill combines the advantages of high-tension, high-interrupting capacity fuses with long life, low maintenance characteristics of contactor-starting equipment

RICHARD R. RANSON, Cutler-Hammer, Inc., Milwaukee, Wis.*



MOTOR CONTROL SWITCHBOARD at the Southland Paper Mills, showing grouping of high- and low-voltage controls in unit sections. The 2,200-volt equipment is at left, 440-volt starters at right



HIGH-TENSION BUS and disconnect fuses of 2,200-volt motor control units are in upper compartment, while low-tension contactor control equipment is below

THERE has been much discussion of the adaptability of 2,200-volt contactor type motor control equipment to systems having high short-circuit possibilities. In the past some engineers have specified circuit breakers for motor control applications in order to insure adequate interrupting capacity. The use of circuit breakers has implied increased costs of installation and increased maintenance. This article will describe a modern installation of motor control which combines the advantages of high-interrupting-capacity, high-tension fuses with the long-life, low-maintenance characteristics of contactor-starting equipment.

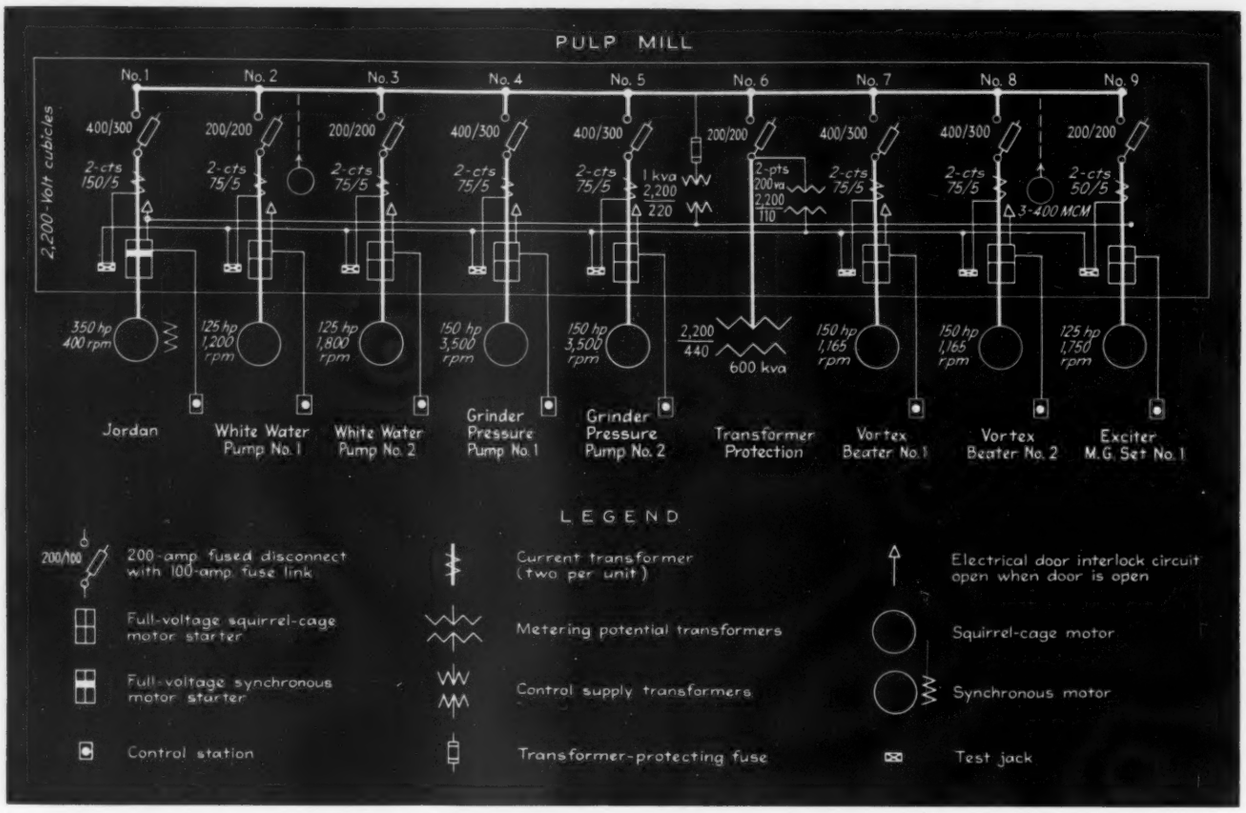
The system, to be described, was worked out for the Southland Paper Mills, Inc. Consulting engineer for the project was George F. Hardy; the general contractors, Merritt, Chapman & Scott Corp.

Main power distribution about the Southland plant is at 2,200 volts, three phase, 60 cycles. Large drives of 125 hp. and above are operated directly from the 2,200-volt system, while power transformers ranging from 300 to 600 kva., 2,200/440 volts located at convenient "centers" supply power for motors of 100 hp. and under.

Selection, installation and operation of motor control equipment for 2,200-volt and 440-volt service was one of the problems requiring careful consideration. It was highly desirable to hold the final arrangement of motor-starting equipment until all the various special machinery details had been settled and their relation to other equipment determined. This required, in some cases, that the final motor control switchboard arrangements be determined at the time motor starters were actually being installed on the job.

Such a condition would obviously introduce serious complications in the design of shop-fabricated switch-

*Design engineer.

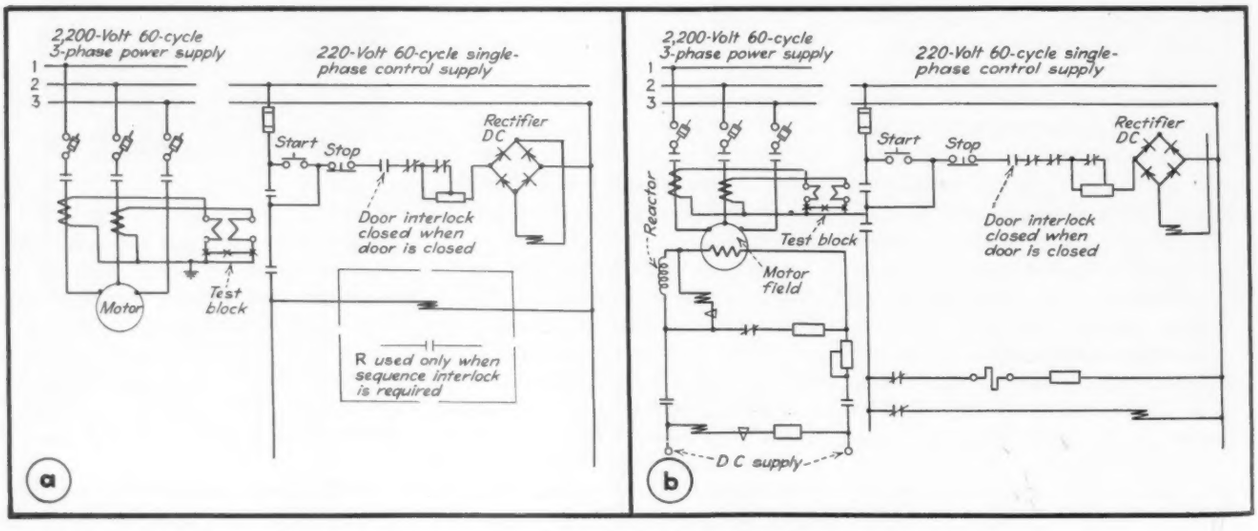


SINGLE-LINE DIAGRAM of typical 2,200-volt motor control equipment

boards, which call for complete and accurate description of functions of apparatus at an early enough date to permit design and construction. This situation was met by adopting unit-type starters in a range of sizes which could be set together to accomplish a finished switchboard appearance and provide all the features of strength, isolation and wiring convenience that a factory-fabricated board would have. As finally worked out, this arrangement (shown) gave the requisite flexibility of assembly to meet the situation.

In laying out the unit-type control system the 2,200-volt equipment determined the switchboard height. The 440-volt starters and distribution units were arranged to stack to the same height. Two 440-volt NEMA size 4 starters, placed one on top of the other, equal the height of the 2,200-volt equipment. Three NEMA size 1, 2 and 3 starters, one above the other, equal the same height. NEMA size 2, 3 and 4 starters are of the same width and equal the width of two of the NEMA size 1 starters. Depth of the 440-volt starters is such that they can be installed back to back with sufficient space between for wiring and with the faces of the starters flush with the front and rear of the 2,200-volt section.

Characteristics of generating and distribution equipment and circuits were such as to permit an estimated maximum short-circuit current of



LINE DIAGRAM of (a) high-tension squirrel-cage motor control and (b) high-tension synchronous motor control

10,000 r.m.s. amperes in the 2,200-volt motor branch circuits. This short-circuit value requires special attention to conductor bracing, thermal capacity and interrupting ability in the 2,200-volt control unit sections.

To meet this condition busbars in such sections were supported on porcelain pillar type insulators. This mounting arrangement (shown in one of the pictures) provided a maximum rigidity with ample strength, spacing and insulation for all operating conditions.

High-tension fuses of the solid material type in special disconnecting fuse mountings were used for branch circuit protection. These fuses are particularly adapted to installations where high interrupting capacity is required. Fuse time characteristics are given on the accompanying curve. The 200-amp. size fuse has a short-circuit interrupting capacity of 1,500 r.m.s. amperes at 2,200 volts and the 400-amp. size capacity is 25,000 r.m.s. amperes. On medium to heavy short-circuit currents the melting time is so short that the fuse usually clears in not more than one cycle.

A special condenser unit forms a part of each fuse holder assembly. It condenses vapor liberated from the solid arc extinguishing material during short-circuit interruption, thus insuring safe, positive operation of

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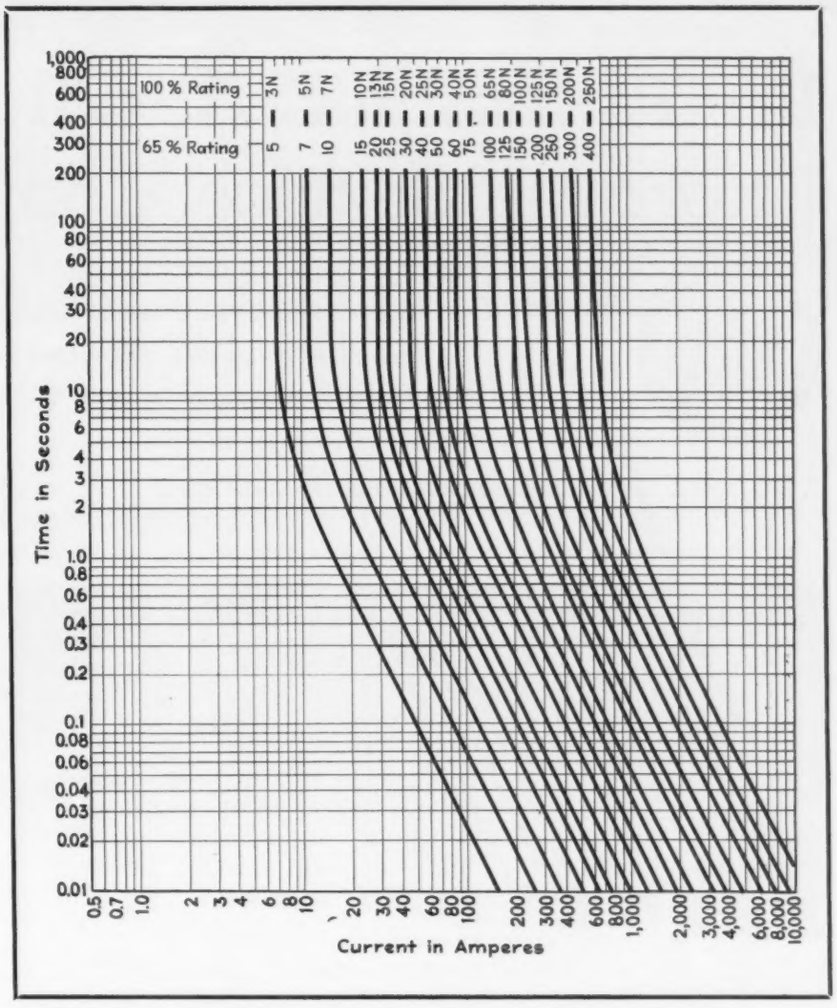
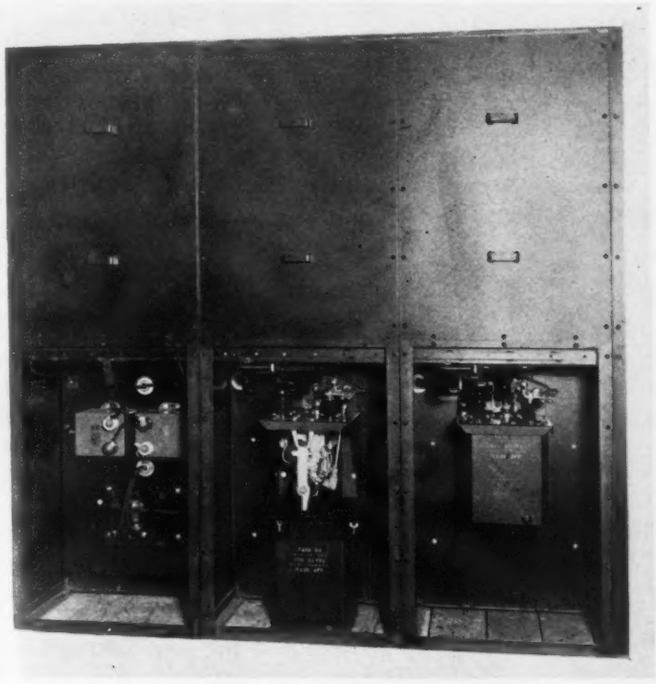
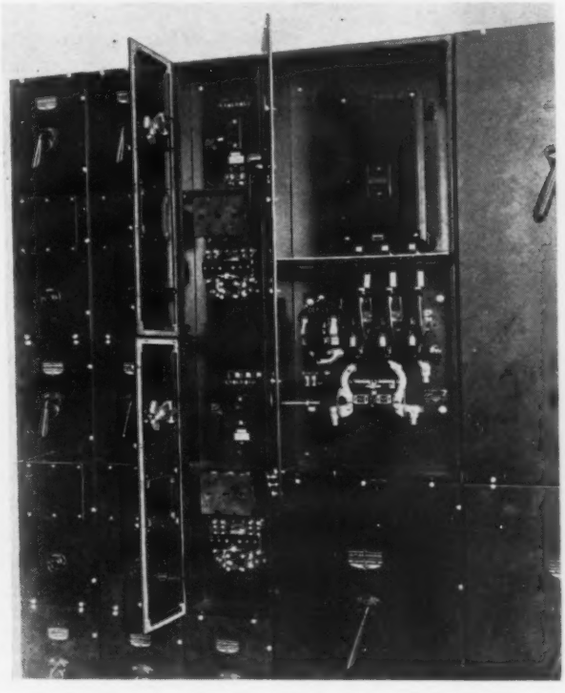


TIME-CURRENT CURVE of 10 to 400 amp. S & C type SM fuses





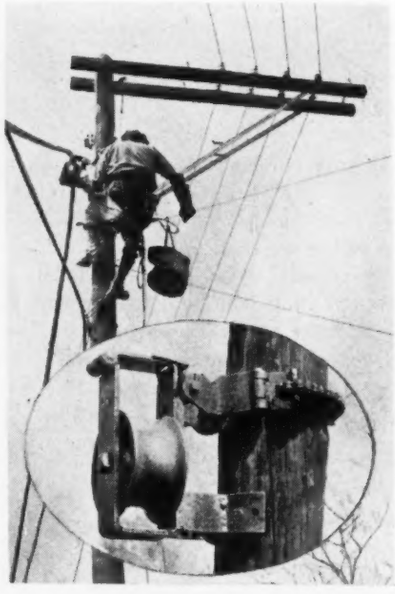
REAR of 2,200-volt motor control switchboard with oil immersed contactor tank lowered in center cubicle (left). Typical compartments in 440-volt motor control switchboard (right)

Pre-Assembled Aerial Cable Improves Service Continuity

Self-supporting 5-kv. cable combines messenger, cable and rings in assembly strung as a unit — Cost approaches open-wire construction — Latest development in utility's use of overhead cables for primaries

C. H. LE VEE, Central Hudson Gas & Electric Corporation

PRE-ASSEMBLED CABLE is strung as a unit. Cable can't whip into existing open-wire primary lines when installed under them, as in this instance



SPECIAL BLOCK, developed to aid pulling-in of cable, is mounted directly on the pole (insert)

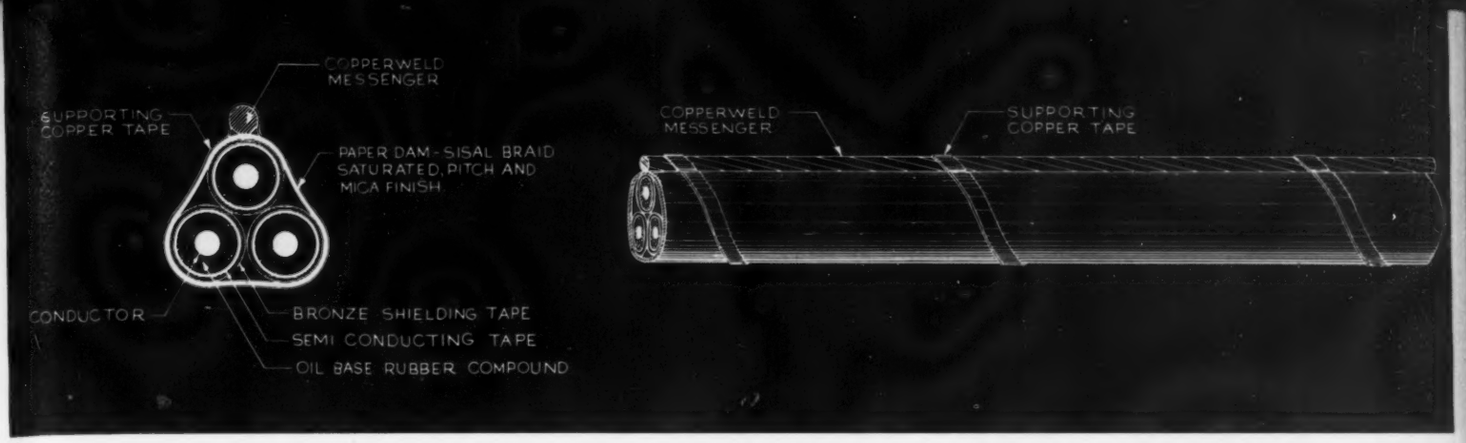
Hinge at top enables it to swing out horizontally at corners. In this view the cable has been drawn up to nearly the proper sag, so the lineman is preparing to open the top guard on the block. After he cuts back about 36 in. of the binding tape he'll fasten the exposed messenger into the standard messenger clamp shown just above his left shoulder. Then the cable will be pulled up to the final sag.

BY THE USE of recently developed self-supporting 5-kv. aerial cable some 50,000 ft. of which has been installed within the past year for both single- and three-phase services, using conductors to No. 1/0, we have been able further to reduce the spread of costs between open wire, plus the capitalized cost of initial and recurring tree trimming, and cable construction, so that we are able to justify more cable lines. Thus we have not only improved the appearance of our lines and eliminated customer reaction to tree trimming, but have also improved the continuity of our service through more reliable construction.

For the past eight or nine years (ELECTRICAL WORLD, July 8, 1933, page 56) our company has been installing increasing amounts of primary aerial cable. This came about as a result of our desire to construct overhead distribution lines that were less conspicuous, more durable and would provide better service than was possible by the use of open wire or even tree wire.

This type of construction consists of an oil-base, rubber-compound insulation over a copper conductor. Over the insulation is a semi-conducting tape, then bronze shielding tape and over all a weatherproof covering. This cable is installed in cable rings supported on a Copperweld messenger. In wye circuits, this messenger is also utilized as the neutral wire.

Of course the initial cost of this type of construction is higher than the conventional type of open-wire construction, but if those recurring tree trimming costs which are eliminated in cable construction are capitalized, then the costs of the cable construction approach that of the open wire as the tree trimming costs increase.



SELF-SUPPORTING CABLE combines messenger, cable and rings in factory-assembled unit

Operating experience with aerial cable has been so satisfactory over the past eight years that by the end of 1940 we had installed some 121 circuit-miles of this cable. During 1940, although this amounted to approximately 5 percent of the total length of distribution lines of our company, the number of interruptions caused by these cable lines amounted to only 0.6 percent of the total distribution interruptions. When it is remembered that these cable lines are installed in the more exposed locations as far as tree interference is concerned, the record of this type of construction is even more satisfactory than the figures indicate.

During a sleet storm in the first part of 1940, which accounted for about one-third of the total outages for the year, not one interruption was traceable to any primary aerial cable lines. It was felt that this experience and the wide public acceptance, due to its neat appearance, justified the use of aerial cable for primary distribution, but the cost was still greater than open-wire construction. Consequently, many ideas were advanced to reduce the cost, and from this study a "self-supporting cable" was developed.

Cable Design Details

This cable uses conductors of the same type as the conventional type of primary aerial cable, minus the weatherproof covering over each conductor. Also, some color scheme is used to identify each conductor in a multiple-conductor cable. The cables are twisted together with about a 42-in. lay and wrapped with impregnated sisal braid, no fillers being used. This is then wrapped to a $\frac{3}{8}$-in. Copperweld messenger, with a soft-drawn, flat copper tape 0.040 x 0.30 in. with about an 8-in. spacing, the Copperweld messenger being parallel to the conductor assembly. (On wye circuits this messenger serves as the neutral, as in the more conventional cable installations.)

Use of this cable has necessitated some special development for installation. Special blocks were needed and these were designed for mounting directly on the pole. They are so hinged at the top that they will assume a horizontal position on corners.

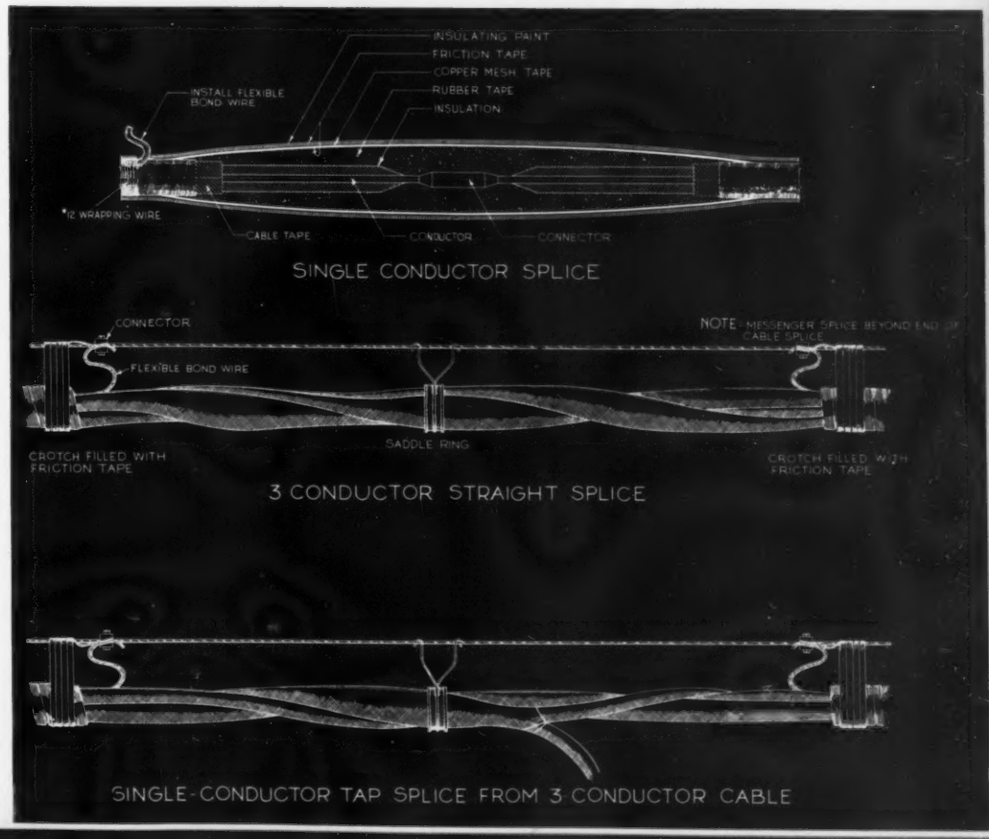
The cable is installed in this manner. A "bull rope" is fastened to the messenger and pulled through the blocks which have been fastened to the pole immediately below the standard through-bolt and messenger clamp usually used for cable and messenger construction. When a length of cable has been pulled out (usually 800 or 1,000 ft.) it is fastened at one end and pulled up almost to the correct sag. Then the top guard on the block is opened, the copper binding tape removed for about 36 in. and the messenger, so exposed, slipped into the conventional messenger clamp and the cable pulled up to its final sag by sighting. No lightning arresters are used at transformer locations, though they are used at the beginning and end of installation where a tap is made onto an open-wire circuit. Cutouts are used at transformer locations and for sectionalizing.

Cuts Installation Costs

Not only has this type of construction reduced the cost of installation by 25 to 40 percent but the assembled cable is less costly than the component parts of the conventional type of aerial cable installation. In addition, it has reduced the hazard when installing under existing open-wire primary lines, since there is no possibility of the cable whipping

[*Continued on page 73*]

CABLE SPLICES are modifications of standard construction for aerial cable



Secondary Network Planning—I Basic Data, Initial Estimates

What information to assemble? How plan secondary grid? What about concentrated loads? What size transformers and how far apart?

H. G. BARNETT, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

APPARENT complexity and lack of common understanding of the design of a secondary network system have probably discouraged consideration of a network for many places where it would be economical. Planning a network is actually a simple and straightforward procedure. The ideal method is to use the network calculator because it is convenient and accurate. As in any planning problem, it is necessary to have adequate information on which to base the design of a network. With this information available the procedure then is to lay out an apparently feasible plan. This plan is then studied on a network calculator or by inspection and revised until a good design is obtained.

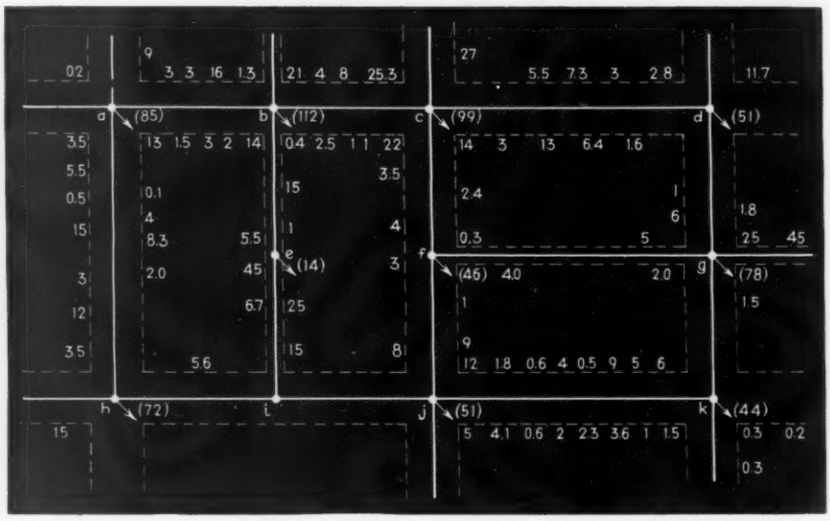


Fig. 1—Typical of loads (distributed and concentrated) for which network is designed. Figures inside dotted lines are loads in kw. of diversified demand at transformers, figures in parentheses are concentrated loads in kva. of ultimate demand at transformers

Required Basic Information

The following should be available before starting to plan a network:

1. The location and size of the various loads at the services should be known, especially for the large loads in the area. Location and size of existing transformers can be used as a basis of design but actual loads are more satisfactory. Diversity among loads should be considered. Anticipated load growth should be known and considered; a network should be designed for loads three to five years in the future.

2. The number, voltage, size, length and carrying capacity of the primary feeders available to supply the network must be known. The number of feeders has a direct bearing on the necessary reserve transformer capacity in the network. The voltage and size will determine whether the regulation in the primaries will be satisfactory. The carrying capacity of all the feeders should be such that the network load can be carried with any one or two feeders out of service, depending on how many feeders are used to supply the network.

3. The location and capacity of the available source of power for the network primary feeders must be known. It is desirable that all the primary feeders come from one station having sufficient firm capacity for the whole network load.

4. A map of the area should show location and size of existing facilities. The network system can frequently use existing secondary copper, primary feeders, transformers, pole lines, ducts and vaults to reduce the initial cost of the network.

5. Preferred and available routings for secondary and primary circuits should be known.

6. Any other factors which may affect the design or operation of the network should be considered.

The accuracy and completeness of this information will determine how well the network can be planned to serve the load in the area.

The characteristics of a radial system can be calculated directly. This is not true in the case of the network because the loads divide among the various transformers and primary circuits in such a way that calculations of the characteristics of the system by ordinary methods become very tedious.

* Central station engineer.

There are two general methods of planning a network system. One is to use a network calculator or a miniature system to determine the characteristics of a system, which must be laid out first by estimation, and then make such revisions as are required. The other method is to estimate a plan and then by inspection estimate the division of load for various conditions; the plan is then revised until the estimated load division gives satisfactory conditions. The following description applies specifically to the first method; however, the general principles apply to either method.

Secondary Grid

The first step is to lay out a secondary grid. This is done on the basis of the location of the loads and the routes of existing secondary mains. In most cases existing secondaries almost completely cover the area and it is only necessary to connect these secondaries into a continuous grid and to add sections of main to provide multiple paths for supply to certain loads. The best apparent secondary main arrangement should be drawn as shown in Fig. 1 by the mesh of solid lines. The area shown is a part of an overhead network for the downtown district of a small city; this area is typical of the problem of designing a network and will be used as an example. The present load density in the network area is about 19,500 kw. per square mile; the total load is 1,466 kw.

The next step is to concentrate the loads, in the proper units, at various points throughout the network to reduce to a convenient number the loads to be considered. The distributed loads along each section of secondary main are concentrated usually at the junction points and occasionally at major loads. A good approximation is to divide each load between the adjacent junctions inversely proportional to the distances between the load and the junctions. For example, along main *c-d* (Fig. 1) 58 percent of the 13-kw. load would be assigned to junction *c* and 42 percent to *d*, and 85 percent of the 14-kw. load would be assigned to junction *c* and 15 percent to *d*. When all of the loads are divided in this way the sum of the various components at any junction gives an equivalent concentrated load at that point. After the loads are concentrated they are converted to equivalent diversified demand at the transformer.

In the typical example the concentrated diversified loads in kilowatts were increased by a factor of 1.4. The factor of 1.4 provides for 25 percent load growth (or approximately 7 percent annually for three years) and converts from kilowatts to kva. at 90 percent power factor. The loads are then of such size and so located that they can be set up on a network calculator conveniently, and they accurately represent loads for which the network must be designed.

Where a large individual load is served from a point along a section of main, such as at point *e* (Fig. 1) it is preferable to consider that load at that point and possibly locate a transformer adjacent to the load, even if there is no junction with other secondaries. The load near some points, such as *i*, may be so light that a concentrated load need not be considered.

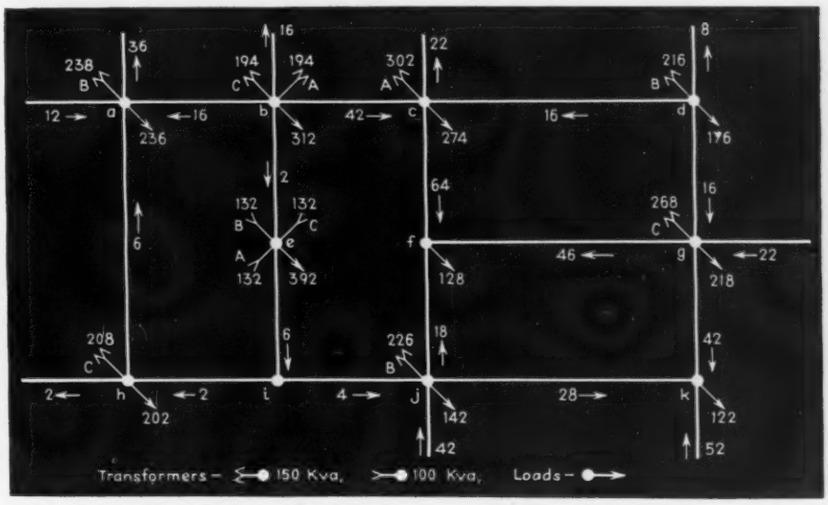


Fig. 2—Section of typical network showing location of transformers, feeder interlacing and normal load division in amperes when all feeders are in service

Selecting Transformers

When the loads and secondary grid have been determined the approximate sizes and locations of transformers can be selected. The transformer size will depend on the type of system, size of concentrated loads, number of feeders available, the feeder interlacing and spacing of the transformers. In general, the larger the transformer the lower the cost per kva. and the wider the spacing between transformers in the network. For large spacings the secondaries must be larger to keep secondary voltage drop within reasonable limits and to provide adequate carrying capacity. Fewer transformers require less primary cable. The ideal size of transformer is that which not only will handle the loads but also give a minimum total cost, including costs of primary feeders, transformers and secondary mains.

Transformers in overhead networks should be 150 kva. or less in order to utilize available light-duty network protectors. In underground systems the transformers will usually be larger than in overhead networks because of higher load densities and the cost of vaults. The most common sizes of underground network transformers are 300 and 500 kva., although 750- and 1,000-kva. transformers are sometimes used.

Interlacing of the primary feeders and the available number of feeders determine the required reserve transformer capacity. For networks supplied by six feeders or less it is reasonable to assume that not more than one feeder will be out of service at any time during peak load. This means that the total transformer capacity in service with any one feeder out of service must be adequate to carry the total peak load. The accompanying table gives the ideal ratio of peak load to total transformer capacity in a network for two to six feeders.

Going from two to three and from three to four feeders improves the ideal ratio rapidly, but as the number of feeders is increased further the

[*Continued on page 69*]

Contract Construction Work Among the Electric Utilities

Types of construction — Factors influencing the letting out of contract work — Allowances for supervision — Services supplied by contractor

ELECTRIC utility companies are tending to increase electrical construction work done by contractors. This is borne out by a recent survey in the electric utility field; replies have been given by 89 public utility and associate companies throughout the United States.

Substantial electrical construction jobs were awarded to contractors by more than one-half of the companies that sent in replies to questionnaires. For practically the same number of companies the contract awards in 1940 amounted to approximately $61,900,000. The kinds of contracts in the order of number of companies letting jobs are: (1) Power plant construction, (2) tree pruning, (3) transmission line construction, (4) substation construction, (5) pole setting, and (6) duct line installation. Only one company reported that holding company construction did the work. However, a couple of operating companies had engineering done by holding companies.

Approximately one-half of the companies that had let contracts are disposed to increase the proportion of total construction activities let to contractors.

Answers to specific questions regarding the contract work were given by 78 utilities. These answers are summarized in the following:

Jobs were bid competitively for approximately three-fourths of the companies giving replies. However, in some cases, the jobs were let on a "cost plus percentage" basis, on a "man-day basis" and on a "unit cost basis." Competitive bids were received for major power plant equipment, and in several cases the equipment was installed by the manufacturer.

Recapitulation of replies shows the following order of importance of factors which influence letting out of work to contractors:

1. Stabilized utility employment.
2. Minimized investment in construction equipment.
3. Skilled workmanship in construction.
4. Entry of established cost for the work.

Following factors were considered as first in importance by several companies:

A. Contractors specialized organization and equipment.
B. Avoidance of abnormal increases in construction forces.
C. Where saving in costs are available.

Other replies gave the following as having an important bearing:

(a) Greater public confidence.

Survey of Contract Construction Tabulation of Replies

1. Does your company let substantial electrical construction jobs out to contractors?

Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
48	54.5	32	35.9	1	8

2. Is your work done by holding company construction forces?

Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
1	1.1	69	77.5	2	17

3. Is there a disposition to increase the fraction of total activities allotted to contractors?

Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
39	43.9	38	42.6	..	12

4. Were the jobs bid competitively?

Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
47	59.4	14	17.9	3	14

5. Which party, utility or contractor, generally (a) does the preliminary engineering, (b) draws the specifications, and (c) provides the inspection?

	Utility	Percent of Total Replies	Contractor	Percent of Total Replies	Qualified Replies	No Replies
(a)	61	78.2	1	1.2	2	14
(b)	54	69.3	6	7.7	4	14
(c)	57	73.0	3	3.8	4	14

6. Does the contractor furnish (a) labor, (b) supplies, (c) installed equipment, (d) engineering, (e) inspections?

	Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
(a)	60	76.9	..	....	..	18
(b)	37	47.5	19	24.4	2	20
(c)	20	25.6	36	46.2	1	21
(d)	15	19.2	43	55.1	..	20
(e)	11	14.1	46	59.0	..	21

7. Which party supplies the guards or police for the job in progress?

Utility	Percent of Total Replies	Contractor	Percent of Total Replies	None Used Thus Far	Qualified Replies	No Replies
15	19.2	27	34.6	9	7	20

8. In general, has contracted work been performed satisfactorily?

Yes	Percent of Total Replies	No	Percent of Total Replies	Qualified Replies	No Replies
60	77.0	..	....	..	18

(b) Avoids interference with operating personnel.
(c) Public relations.
(d) Do not have sufficient construction work to keep a crew of trained and skilled employees available.

Preliminary engineering was done by practically all of the companies replying. In two cases the preliminary engineering was attended to by both the utility and the contractor. In one case the contractor did the preliminary engineering.

Specifications were drawn up by most of the utilities. In a few cases the contractor drew the specifications. For some major jobs engineering consultants were called in.

Inspection was provided by practically all utilities replying, and in a few cases it was provided by the contractors. On some major jobs engineering consultants took care of the inspection.

Labor was the principal charge for the contractors. Supplies were second on the list. Two utilities replied that on general contracts and on small jobs supplies were furnished by the contractor, but not on large jobs or on electrical installations.

Contractors furnished equipment for about one-third of the utilities. They furnished also some engineering.

Allowance for Supervision

Where labor was contracted on a man-day basis allowance was made for overhead supervision, use of tools, etc. The total allowance ranged from 10 to 25 percent; in one case 20 percent was allowed for line work and 17 percent for plant construction; another reply gave "45 percent of estimated labor and vehicle costs." Some breakdowns of allowances were as follows: 15 percent for overhead and 5 percent for use of tools; 10 percent and 2 percent, and 8 percent and 3 percent. A number of utilities replied that no allowances were made because (1) they do not use man-day basis, (2) contracts usually include supervision, use of tools, etc., and (3) labor alone is not contracted for.

What machinery is customarily provided to settle disputes between utility and contractors? Replies to this question show that there is real cooperation between the contracting parties. The greatest number of replies stated that there were no disputes, or that settlement was made by arbitration or negotiation. For the latter, a typical reply was, "None have arisen that personnel of two parties could not straighten out."

A few companies replied that contracts carried provisions for settlement of disputes, while a lesser number of utilities advised that no provisions were included in the contracts.

Contractors supplied the guards or police for the jobs in progress, according to about one-half of the replies; the utility, according to about one-fourth of the replies; and for a number of jobs, "none used thus far."

Some replies relating to supplying guards and police were, contractor or utility or both; contractor, on large jobs; utility, on small jobs; depends on contract; contractor usually furnishes watchmen or guards, but on occasions, mostly in production department, the company furnishes watchman.

The utilities have advised that contracted work has been performed satisfactorily—this, according to 100 percent replies received for the particular question. In fact, "very satisfactory" was included in the replies.

Secondary Network Planning

[*Continued from page 67*]

saving in transformer capacity decreases, so that there is little gain in going from five to six feeders. This is especially true for the ratio that usually can be attained. The ideal ratio would be realized only if the transformers could be loaded exactly to their capacities and the load could be divided uniformly among the units in service at any time. Obviously, these conditions do not occur and the ratio that actually is obtained is usually about that shown in the right-hand column of the table. It is interesting to note that the ratio of total peak load to total transformer capacity of 121 networks in 1937 was 44 percent. This value is based on actual load and transformer capacity; the transformer capacity in the actual networks probably provides for some load growth beyond the actual loads. The factors in the table are based on loads for which a network is designed and which include both actual and anticipated load growth.

For the purpose of estimating the trial plan for the network the transformers should be located at the major loads and at the various junctions where the concentrated loads are large enough, so that the distance between transformers is not greater than about two blocks or 600 to 800 ft. Usually the spacing will be less than this because of the location of loads. It is generally desirable to select not more than two sizes of network transformers. This reduces to a minimum the stock of spare transformers and protectors and increases interchangeability of units.

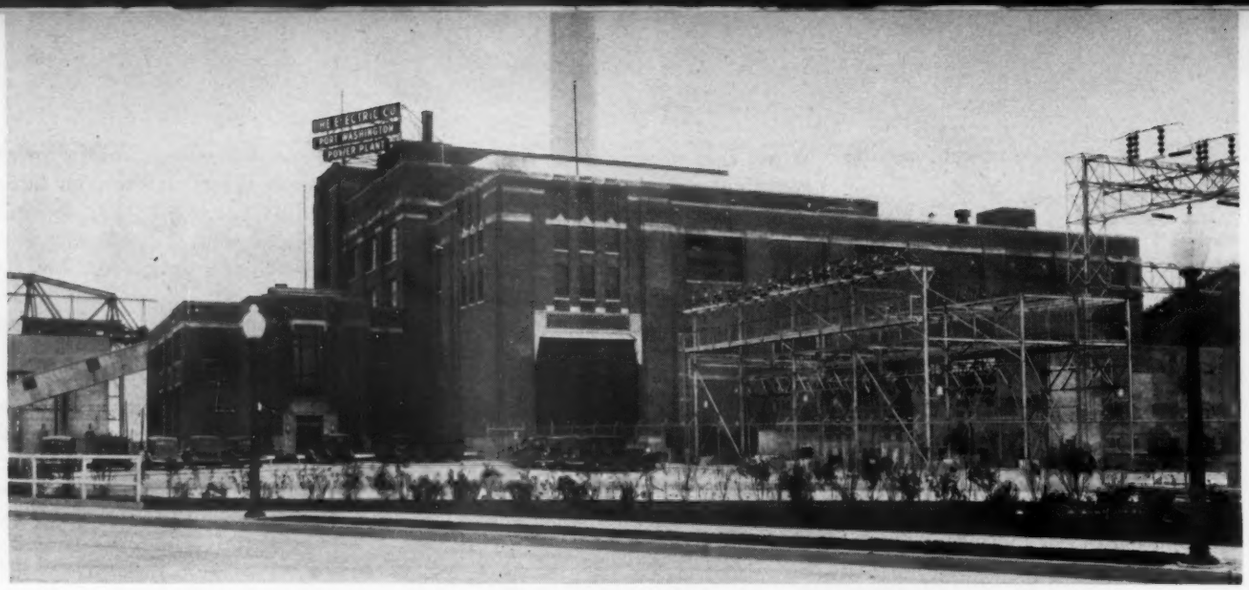
In the example three feeders were available and the network was to be overhead. On the basis of the size of loads and the use of three feeders, 100- and 150-kva. transformers were located as shown in Fig. 2.

At points where large concentrated loads are served it is desirable to use two or more transformers rather than one transformer much larger than the rest of the units. This avoids a large number of sizes and the use of a few units of a size that is not interchangeable with the predominating size. In addition multiple unit installations improve load distribution and voltage regulation at the large loads under emergency conditions. For example, if at point *e* in Fig. 1 one large transformer instead of three smaller units were used a third size of transformer would be introduced. In addition, if a single transformer at point *e* were out of service the large load at that point would have to be supplied over rather long sections of secondary main. This would require heavy secondary copper and also result in poor voltage regulation.

Ideal Ratio of Peak Load to Total Transformer Capacity in Network Supplied by Two to Six Feeders

Number of Feeders	Ratio of Peak Load to Transformer Capacity	
	Ideal	Usually Attainable
2	0.50	0.4
3	0.667	0.54
4	0.75	0.58
5	0.80	0.60
6	0.83	0.61

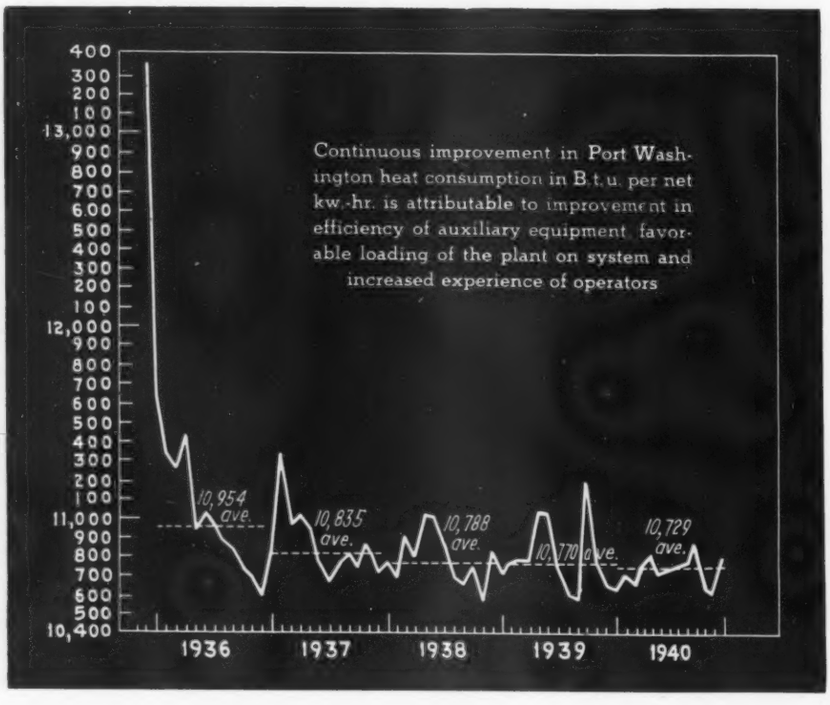
Transformer impedance should be between 3 and 6 percent. Standard network transformer impedance is 5 to 5.5 percent. Low impedance improves regulation and fault-clearing ability in a network, while high impedance improves the load division among the transformers in service under emergency conditions. The range from 3 to 6 percent is usually the best compromise; 81.3 percent of network transformers in service in 1937, for which information is available, have impedances in that range.



Port Washington station, Wisconsin Electric Power Company, the world's most efficient power plant, which recently completed its first five years of operation

Port Washington Establishes Five-Year Economy Record

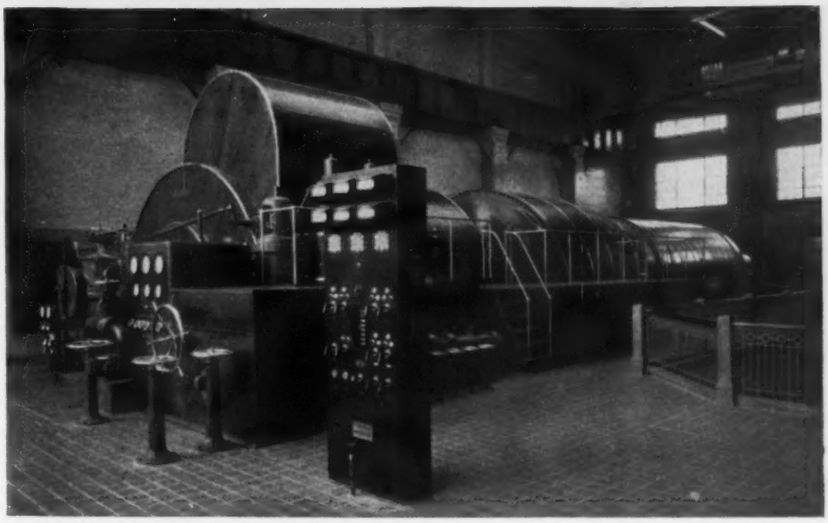
Continuous downward trend of heat consumption curve, reaching a low of 10,729 B.t.u. per kw.-hr. net for 1940, and 90% plant availability are high points of performance record of world's most efficient power plant



PERFORMANCE RECORDS of Port Washington station for its first five years of operation show a steady decrease in annual net station heat consumption from a "high" of 10,954 B.t.u. per kw.-hr. for 1936 to a "low" of 10,729 B.t.u. per kw.-hr. for 1940. Average consumption was 10,813 B.t.u. per kw.-hr. for the five years. During that period the station was in operation 87.8 per cent of the time and had an availability of 89.9 per cent.

Port Washington station, to review briefly, is an 80,000-kw., single-unit plant owned by Wisconsin Electric Power Company and located on Lake Michigan, 28 miles north of Milwaukee. Salient features of the plant, which operates on the reheat cycle, are: One 690,000-lb.-per-hour Combustion Engineering boiler delivering 1,230-lb. steam at 825 deg. to the throttle of an Allis-Chalmers 80,000-

kw. tandem-compound turbine operating at 1,800 r.p.m. Generator is rated 85 percent power factor, is air-cooled and operates at 22,000 volts. Powdered coal (13,000 B.t.u. per lb.) is burned in a dry bottom furnace having a volume above the water screen of 58,000 cu.ft. and 14,000 cu.ft. below. Boiler is of the three-drum, bent-tube type with an area of 44,087 sq.ft. and with a combination radiant and convection superheater, the former having an area of 8,700 sq.ft. and the latter 1,464 sq.ft. There are 7,976 sq.ft. of water walls. An all-radiant heater is located in the rear wall of the furnace. Auxiliaries are all electrically driven except one boiler feed pump and one house service pump, which are both steam-driven under emergency conditions.



80,000-KW. TURBO-GENERATOR at Port Washington—a second similar unit is to be added in 1942

Work is currently in progress on a second 80,000-kw. turbo-generator and 690,000-lb.-per-hour boiler, with which it is planned to double the station's capacity in 1943. Similar to existing equipment in most respects, the design of the new installation is advanced sufficiently to justify expectations that the thermal efficiency record of the present installation will be

Port Washington No. 1—Five-Year Performance Record

Year	Elapsed Hours	Available Hours	Operated Hours	Output Net Kw.-Hr.	Ave. Load (3)	Peak Load	Load Factor % (1)	Availability Factor % (2)
1936	8,784	7,884	7,612	382,863,218	53,100	82,000	57.5	89.8
1937	8,760	7,570	7,390	387,914,490	55,340	81,000	58.4	86.4
1938	8,760	8,320	7,975	393,717,300	52,130	80,000	59.3	95.0
1939	8,760	7,770	7,770	391,411,055	53,200	80,000	59.0	88.7
1940	8,784	7,855	7,855	438,539,937	58,830	82,000	65.8	89.4
5 years	43,848	39,399	38,602	1,994,446,000	54,514	82,000	60.0	89.9

(1) Load factor = kw.-hr. gen. ÷ (elapsed hours × 80,000) (2) Availability factor = (hours available ÷ elapsed hours)
(3) Average load = kw.-hr. gen. gross ÷ operated hours.

Record of Plant Outages by Causes, Port Washington No. 1

Date Started	Date Stopped	Hours Out	Reason for Outage
			1936
11-22-35	3-14-36	245	Scheduled spring inspection
3-24-36	4-18-36	31	Lack of load
4-20-36	4-25-36	31	Lack of load
4-27-36	5- 2-36	31	Lack of load
5- 4-36	5- 9-36	31	Lack of load
5-11-36	5-15-36	55	Replaced bonnet valve on main steam line
5-18-36	5-23-36	31	Lack of load
5-25-36	5-28-36	79	Lack of load and leak in reheater
6- 1-36	6- 5-36	79	Leaky reheater gaskets
6- 8-36	6-13-36	31	Lack of load
6-15-36	7- 3-36	55	Reroll R. H. superheater tubes
7- 6-36	10- 3-36	223	Scheduled fall inspection
10-13-36	11- 6-36	55	Replace equalizer pipe
11- 9-36	11-20-36	5	Broken condenser tube
11-20-36	11-20-36	55	Tighten bolts on turbine main joint
11-23-36	12- 4-36	55	Tube corrosion
12- 7-36	12-17-36	79	Tube corrosion
12-21-36	12-26-36	1	Tube corrosion
Total		1,172	
			1937
	(1)12-26-36	54	Tube corrosion
12-29-37	1- 2-37	33	Tube corrosion
1- 4-37	1-12-37	307	Tube corrosion and repair L.P. turbine
1-25-37	3-14-37	447	Scheduled inspection
4- 1-37	4- 9-37	31	Improving turbine balance
4-12-37	4-17-37	31	Lack of load
4-19-37	4-24-37	31	Lack of load
4-26-37	5- 1-37	32	Lack of load
5- 3-37	5- 8-37	28	Lack of load
5-10-37	5-15-37	29	Lack of load
5-17-37	5-22-37	29	Lack of load
5-24-37	5-27-37	101	Repair pipe joint
6- 1-37	7-16-37	0.5	Error in operation
7-16-37	10- 1-37	217	Scheduled inspection
10-11-37	.....	.....	Still operating on 12-26-37
Total		1,370.5	

Date Started	Date Stopped	Hours Out	Reason for Outage
			1938
11-10-37	4- 2-38	29	Lack of load
4- 4-38	4-10-38	29	Lack of load
4-11-38	4-16-38	29	Lack of load
4-18-38	4-22-38	221	Scheduled inspection
5- 2-38	5- 7-38	29	Lack of load
5- 9-38	5-14-38	29	Lack of load
5-16-38	5-22-38	29	Lack of load
5-23-38	5-28-38	53	Lack of load
5-31-38	6- 4-38	29	Lack of load
6- 6-38	6-11-38	31	Lack of load
6-13-38	6-18-38	29	Lack of load
6-20-38	6-25-38	29	Lack of load
6-27-38	10- 8-38	219	Scheduled inspection
10-17-38	.....	..	Still operating on 12-26-38
Total		785	
			1939
10-17-38	4-22-39	617	Scheduled inspection
5-17-39	8-31-39	215	Tube failure
9- 9-39	10- 3-39	111	Replace eight water screen tubes
10- 8-39	11-24-39	47	Inspect water screen tubes
11-26-39	.....	..	Still operating 12-26-39
Total		990	
			1940
11-26-39	1-19-40	27	Repair leaky hand hole in screen tube header
1-21-40	3-24-40	5	Repair bypass valve in F.W. line
3-24-40	4-20-40	194	Scheduled inspection
4-29-40	8- 9-40	45	Broken blades in last row of L.P. end
8-11-40	9-14-40	576	Scheduled inspection
10- 8-40	12-19-40	82	Screen tube failure
12-23-40	.....	..	Still operating 12-26-40
Total		929	

(1) Operating month ends five days before calendar month.

Port Washington Power Plant, Averages of Operating Data

Date — Month Ending	Annual Averages 1940	1939	1938	1937	1936	5-Yr. Ave.
Coal						
To bunker (tons per day)	550	499	484	513	495	508
Pulverized (tons per day)	551	496	484	515	495	508
Burned, approx. (tons per day)	551	495	484	515	496	508
Mill hours	33.71	29.98	29.24	32.39	33.79	31.82
Mill tons/hour	16.4	16.6	16.6	16.0	14.7	16.1
Mill system kw.-hr./ton	15.1	15.1	14.7	14.6	15.8	15.1
Moisture, mill in. %	4.3	4.0	3.9	3.7	3.6	3.9
Moisture, mill out, %	1.9	1.8	1.7	1.7	1.8	1.8
No. 1 mill fineness % through						
200 mesh	64.78	65.95	65.59	65.28	65.14	65.35
100 mesh	87.77	88.60	88.53	88.78	89.21	88.57
48 mesh	97.75	98.04	97.94	97.86	97.97	97.91
28 mesh	99.77	99.81	99.78	99.74	99.76	99.77
20 mesh	99.98	99.98	99.97	99.96	99.95	99.97
10 mesh	100	100	100	99.99	99.99	100
No. 2 mill fineness % through						
200 mesh	65.87	66.88	66.39	65.06	66.55	66.15
100 mesh	89.11	89.50	88.99	88.58	90.13	89.26
48 mesh	98.23	98.37	97.96	97.78	98.39	98.15
28 mesh	99.83	99.85	99.77	99.73	99.81	99.80
20 mesh	99.98	99.98	99.96	99.96	99.96	99.97
10 mesh	100	100	100	99.99	99.99	100
B.t.u./lb., ash, moist. free	14,941	14,925	14,996	14,967	14,939	14,954
B.t.u./lb., dry	13,644	13,574	13,603	13,552	13,606	13,596
B.t.u./lb., as received	13,003	12,963	13,011	12,983	13,035	12,998
Moisture, %	4.7	4.5	4.4	4.2	4.3	4.4
Volatile, %	34.30	34.43	34.47	34.82	35.87	34.78
Fixed carbon, %	57.02	56.52	56.24	55.72	55.21	56.14
Ash, %	8.68	9.05	9.29	9.46	8.92	9.08
Sulphur, %	1.27	1.32	1.39	1.92	2.51	1.68
Ash fusion temp., °F	2,310	2,294	2,256	2,241	2,199	2,260
Pulverized Coal Composite Sample						
B.t.u./lb., ash, moist. free	14,927	14,930	14,986	14,943	14,965	14,950
B.t.u./lb., dry	13,633	13,574	13,573	13,506	13,623	13,582
B.t.u./lb., as received	13,401	13,343	13,369	13,299	13,414	13,365
Moisture, %	1.7	1.7	1.5	1.5	1.6	1.6
Volatile, %	34.17	34.28	34.28	34.43	35.80	34.59
Fixed carbon, %	57.16	56.64	56.29	55.95	55.23	56.26
Ash, %	8.67	9.08	9.43	9.62	8.97	9.15
Sulphur, %	1.26	1.31	1.39	1.86	2.51	1.67
Boiler Room						
Steam, million lb./day	10.733	9.599	9.576	9.924	9.733	9.913
Feedwater, mil. lb./day	10.700	9.548	9.407	9.801	9.556	9.802
Ave. output, thds. lb./hr.	449	404	403	420	412	417
Hours steaming per day	23.92	23.77	23.78	23.62	23.65	23.75
Hours banked per day	.01	0	.16	.16	.22	.11
% excess air	18	19	19	23	20	20
Pressure, lb. G	1,289	1,221	1,216	1,190	1,225	1,228
Feedwater temp., °F	395	388	388	378	381	386
Feedwater press., lb. G	1,499	1,400	1,379	1,368	1,421	1,413
B.F. pump eff., % actual	67.3	60.6	63.3	65.9	65.4	64.5
B.F. pump eff., % standard	66.1	65.0	66.1	64.9	65.1	65.4
% comb. in fly ash	12.26	10.77	14.00	12.09	13.42	12.51
Exh. to htrs. thd. lb./day	1.2	.9	1.7	2.6	15.2	4.3
Steam temperature, °F.						
Rad. suphtr. out	691	692	687	673	675	684
Con. suphtr. out	841	842	842	839	831	839
Reheater in	536	538	537	538	534	537
Reheater out	838	841	842	840	831	838
Gas temperature, °F.						
Air heater in	757	730	726	741	734	738

Date — Month Ending	Annual Averages 1940	1939	1938	1937	1936	5-Yr. Ave.
Boiler Room. Cont.						
Gas temperature, °F. Cont.						
Air heater out	394	374	365	375	378	377
Drop	363	356	361	366	356	361
Air temperature, °F.						
Air heater in	180	180	180	171	159	174
Air heater out	584	546	546	551	549	555
F.D. fan in	116	115	117	118	115	116
Rise	468	431	429	433	434	439
% air through heater	88	93	95	95	92	93
Htr. perform., % of std.	102	102	107	101	97	102
Flue gas washer performance						
Ash & refuse to washer, tons	1,415	1,185	.....	.....	.....	1,300
Refuse removed, tons	988	982	.....	.....	.....	985
Efficiency, %	69.8	82.9	.....	.....	.....	75.8
Turbine Room						
Ave. load, kw	58,570	52,938	52,130	54,885	52,771	54,295
Temperatures, °F.						
Throttle	837	836	835	831	825	833
1st inlet	825	820	817	820	809	818
Reheater inlet	543	542	540	544	541	542
Reheater outlet	832	830	829	829	822	828
No. 3 heater	503	501	499	500	488	498
Pressures, lb. G.						
Throttle	1,269	1,198	1,184	1,166	1,184	1,200
1st inlet	1,133	1,008	987	1,035	986	1,030
Reheater inlet	291	260	254	270	258	267
Reheater outlet	260	231	224	239	229	237
No. 3 heater	40.3	34.8	34.5	37.6	34.5	36.3
Stage efficiencies, %						
1st inlet to rehtr. inlet	80.7	80.6	80.6	80.2	77.9	80.0
Rehtr. out. to No. 3 htr.	82.9	83.6	84.5	84.3	85.4	84.1
Both	82.0	82.3	82.8	82.5	82.1	82.3
Cir. water out, F	50.8	50.5	50.5	49.8	50.8	50.5
Cir. water in, F	46.2	46.3	46.6	45.7	46.7	46.3
Cir. water rise, F	4.6	4.2	3.9	4.1	4.1	4.2
Condensate, F	57.6	56.7	57.5	57.5	58.5	57.6
Exh. press., hg. abs.						
Actual	0.52	0.49	0.49	0.49	0.56	0.51
Standard	0.52	0.51	0.51	0.51	0.51	0.51
High (+) or low (−)	0.00	−0.02	−0.02	−0.02	+0.05	0 00
Air pump inlet	0.44	0.42	0.43	0.46	0.54	0.46
Air leakage, CFM	3.0	3.2	3.7	3.6	3.1	3.3
Electrical						
Output, gross, 1,000 kw.-hr./day	1,409.0	1,253.5	1,234.8	1,301.9	1,256.2	1,291.1
Output, net, 1,000 kw.-hr./day	1,338.0	1,187.4	1,169.8	1,235.4	1,190.8	1,224.3
Auxiliaries, 1,000 kw.-hr./day	71.0	66.1	65.0	66.5	65.4	66.8
Auxiliaries, %	5.0	5.3	5.3	5.1	5.2	5.2
% for coal prep	0.59	0.60	0.57	0.58	0.62	0.59
% for B. R. fans	1.09	1.08	1.03	1.06	0.98	1.05
% for B. F. pumps	1.53	1.63	1.58	1.48	1.57	1.56
% for circ. pumps	1.03	1.18	1.16	1.09	1.13	1.12
% for miscellaneous	0.82	0.81	0.96	0.89	0.90	0.88
Station Water Rate, lb./kw.-hr.	7.59	7.62	7.62	7.53	7.61	7.59
Station Heat Consumption, B.t.u./kw.-hr.						
Gross	10,182*	10,198*	10,217*	10,277*	10,376*	10,248*
Auxiliaries	547*	572*	571*	558*	578*	565*
Net	10,729*	10,770*	10,788*	10,835*	10,954*	10,813*

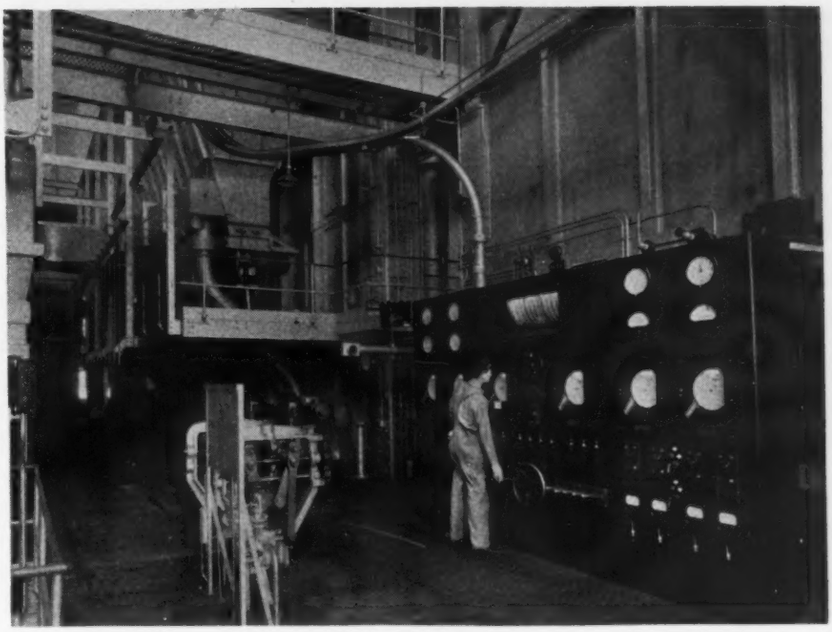
*Weighted average.

Use and Available Data

Year Equipment	1940 Average Boiler	Turbine	Plant	Five-Year Average Boiler	Turbine	Plant
Annual Use Factor = Service Hours / Annual Hours	89.5	89.4	89.4	88.0	87.8	87.8
Hourly Output-Capacity Factor = Ave. Hourly Output / Rated Hourly Output	64.9	73.5	73.5	60.9	68.2	68.2
Annual Output-Capacity Factor = Annual Kw.-hr. / Annual Rated Kw.-hr.	58.1	65.8	65.8	53.6	59.9	59.9
Annual Demand Factor = Demand Hours / Annual Hours	92.9	96.5	100.0	93.4	95.4	97.9
Demand Availability Factor = Service Hours / Demand Hours	96.3	92.7	92.7	95.2	93.1	90.5
Annual Availability Factor = 100 − Repair Hours / Annual Hours	90.3	92.9	89.4	93.3	94.0	89.9

improved upon. Among other factors contributing to this improvement will be the use of hydrogen instead of air cooling for the 80,000-kw., 1,800-r.p.m. generator.

In operating the plant at a five-year average load of 54,295 kw. (load factor 60 percent) 508 tons of pulverized coal with an average heat content of 12,998 B.t.u. per lb. (as received) were burned per day. This, for the average daily net output of 1,224,300 kw.-hr., represents a coal consumption of 0.83 lb. per kw.-hr. for the five-year period. Station water rate was 7.59 lb. per kw.-hr.; average steam output 417,000 lb. per hour or 60.6 percent of boiler rating.



PORT WASHINGTON boiler room. Operating panels are at right, the boiler with its 20 coal feeder pipes are visible at the center of this view

Heat Consumption

Gradual improvement in heat consumption, which for five years has held for Port Washington the title of "World's Most Efficient Station," can be traced to several factors. Prominent among these are (1) improvement in the efficiency of certain auxiliary equipment, such as boiler feed pumps and extraction heaters; (2) more favorable loading of the plant as the system load has increased, and in 1940 a reduction in the amount of hydro-electric power sent into the system from interconnected companies, and (3) increased experience on the part of operators.

The high plant availability factor, 89.9 per cent for the five years, testifies to the plant's relatively trouble-free operation. By far the greater part of the plant outage time, 74.6 percent to be exact, was for scheduled inspection and for lack of load due to an excess of hydro-absorption into the system.

Availability

Most serious operating difficulty resulted from accelerated corrosion of the water screen tubes at the point of highest heat input. On one occasion a new $\frac{3}{8}$-in. tube corroded through in five days. In the last analysis the trouble was attributed to excessive temperature differences between two sides of the tubes in the water screen. This was believed to have set up electrical potentials, resulting in electrochemical corrosion, which was accelerated by high water alkalinity of an oxygen-reducing nature. Through controlling alkalinity—guided by hydrogen measurement—and maintaining water non-oxygen reducing in nature, it was found that a neutral protective film was formed in the tubes, which eliminated the *rapid* corrosion difficulties.

To carry heat away from the upper tube surface and reduce the temperature differential between the hot upper and cool lower surfaces a swirling action was produced within the screen tubes by pushing helical-shaped steel strips into the screen tubes where trouble was most pronounced. When trouble ceased in these tubes and appeared in tubes without helices their use was extended, until all tubes are at present equipped with full-length helical strips.

The last outage caused by corrosion resulted from a failure in a portion of a tube not provided with a helix to aid circulation. The installation of full-length helices in all tubes has apparently corrected the corrosion difficulty.

Summary of Port Washington Plant Outages

	1936	1937	1938	1939	1940	5-Year Total
1. Elapsed time, hours	8,784	8,760	8,760	8,760	8,784	43,848
2. Plant operated, hours	7,612	7,390	7,975	7,770	7,855	38,602
% of total	86.7	84.4	91.0	88.7	89.4	88.04
3. Total outages, hours	1,172	1,370	785	990	929	5,246
% of total	13.3	15.6	9.0	11.3	10.6	11.96
4. Scheduled outages, hours	468	664	440	775	770	3,117
% of total	5.3	7.6	5.0	8.8	8.8	7.11
5. Lack of load, hours	272	180	345	.....	.....	797
% of total	3.1	2.1	4.0	.....	.....	1.82
6. Mechanical trouble, hours	297	132	.....	.....	77	506
% of total	3.4	1.5	.....	.....	.9	1.15
7. Corrosion trouble, hours	135	394	.....	215	82	826
% of total	1.5	4.5	.....	2.5	0.9	1.88

Pre-Assembled Aerial Cable Improves Service Continuity

[*Continued from page 65*]

into the primary lines as the messenger alone might do. There also is no need for a man to ride a cable chair, installing rings on the messenger with his head close to the energized primaries. With this type of aerial cable a 75 percent reduction in the time that a lineman is needed on the pole is obtained.

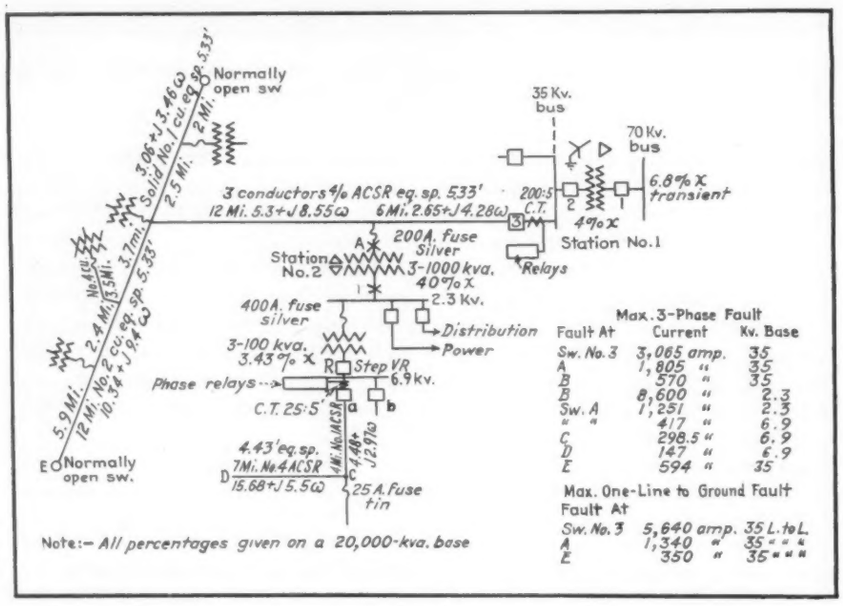
While there is a little more work in installing this type of cables directly through trees, so far this additional work has not been sufficient to offset the over-all efficiency of this method, which is utilized whenever tree-trimming costs are likely to exceed $80 per mile of line per year.

The size and weight of cable to which this construction is adaptable has some limitations, but we have installed cable of this type up to three No. 1/0 conductors without difficulty.

Novel Scheme Coordinates Relays and Fused Taps

Proposes application of instantaneous and time over-current relays to secure selective coordination of relays and fuses on rambling 35-kv. radial lines having fused transformer tap of large kva. near feed point

M. R. HOWELL, Jackson & Moreland, Engineers, Boston, Mass.*


Normally open sw
35 Kv. bus
70 Kv. bus
6.8% X transient
3 conductors 4/0 ACSR eq. sp. 5.33'
12 Mi. 5.3+J8.55Ω
6 Mi. 2.65+J4.28Ω
200:5 C.T.
4% X
Station No. 1
Relays
200A. fuse Silver
Station No. 2
3-1000 kva. 4.0% X
2.3 Kv.
400A. fuse silver
Distribution
Power
3-100 kva. 3.43% X
Step VR
6.9 kv.
Phase relays
C.T. 25:5
4.43' eq. sp. 7 Mi. No. 4 ACSR
15.68+J5.5Ω
25 A. Fuse tin
Normally open sw.
Note:- All percentages given on a 20,000-kva. base
Max. 3-Phase Fault
Fault At | Current | Kv. Base
Sw. No. 3 | 3,065 amp. | 35
A | 1,805 " | 35
B | 570 " | 35
B | 8,600 " | 2.3
Sw. A | 1,251 " | 2.3
" " | 417 " | 6.9
C | 298.5 " | 6.9
D | 147 " | 6.9
E | 594 " | 35
Max. One-Line to Ground Fault
Fault At
Sw. No. 3 | 5,640 amp. | 35 L. to L.
A | 1,340 " | 35 " " "
E | 350 " | 35 " " "

HYPOTHETICAL transmission system with radial feed from 70-kv. bus in station No. 1 and a multiplicity of fused transformer taps

THE JOB of utility relay engineers to limit disturbances caused by system faults to the minimum number of customers generally speaking is not difficult with transmission lines operating at 66 kv. and above. There are relatively few transformer banks tapped to these lines between substations and the high-speed directional relays on the substation breakers clear line faults with little disturbance to customers.

More difficult is the case of rambling 33-kv. lines where a great number of transformer banks are tapped to the line through high-voltage fuses. Coordination of relays and fuses in such cases is desirable, so that interruptions caused by failure of high-voltage bushings and faults within the transformer or on the secondary may be limited to customers served by the bank at fault. But such coordination of relays and fused taps at all fault current values is frequently difficult, particularly when a radial line leading from the circuit breaker is long and has a fused transformer tap of large kva. rating only a short distance from the circuit breaker.

If an attempt is made to obtain selective coordination with the conventional forms of relaying in such cases, it is often found that either the time-lever settings will be so high that heavy current faults near the breaker will not be cleared soon enough or that such high current tap values will be used on the relays that proper protection will not be obtained for faults near the end of the line.

Unorthodox Scheme

This article will discuss in detail the application of a rather unconventional form of relaying to radial lines of this type using over-current relays — both time over-current and instantaneous types — without directional control to obtain selective coordination between relays and fuses.

Fuses and time over-current relays which have inverse timing over a wide current range are best adapted to coordination under these circumstances. Instantaneous over-current relays are useful in maintaining coordination when the system back-up capacity is maximum, even though fault currents under other operating conditions are not high enough to operate them. By providing them with a means for obtaining a definite delay in the tripping of the oil switch these instantaneous over-current relays may be set to reach far into a fuse-protected transformer bank with selectivity and to provide protection far out on the line with a short time interval. This introduces a form of over-current step relaying the value of which seems to have been overlooked. Instantaneous over-current relays used in this manner with a definite time delay in the trip circuit should always have a 90 percent drop-out characteristic.

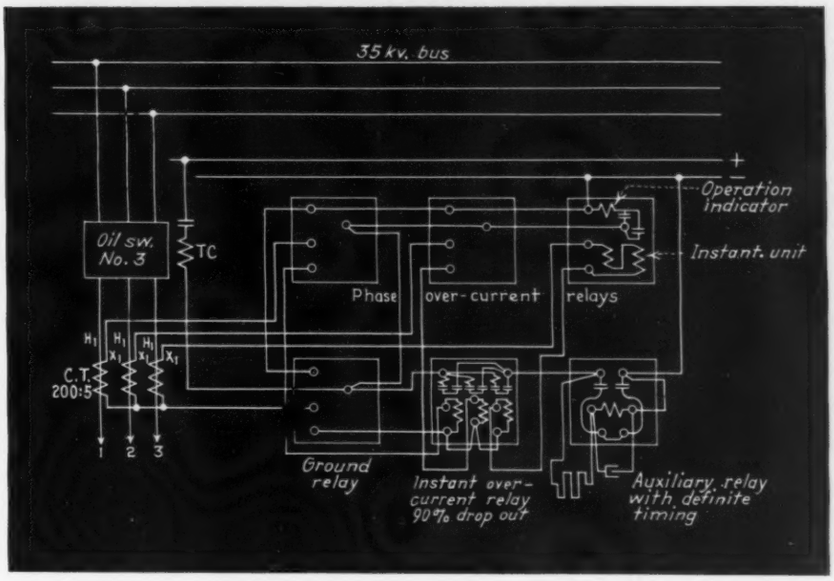
* Author Howell, formerly with Central Illinois Public Service Company, Springfield, Ill., joined the staff of Jackson & Moreland, Engineers, on December 30, 1940—EDITORS.

Instantaneous over-current relays and auxiliary relays connected as described in the following for obtaining a definite tripping time are low in cost and very dependable. However, it is often possible to obtain strict selectivity without resorting to instantaneous over-current relays if fuses and time over-current relays having an inverse time characteristic over a wide range are used.

Selective Coordination

In the following a method of obtaining selective coordination for the 35-kv. line illustrated will be described. This line is fed from a 70-kv. to 35-kv. step-down substation. It illustrates typical conditions confronting the relay engineer of a company giving service to small cities or towns and to coal mines scattered over an extensive territory.

Referring to the diagram, it will be noted that the distance in ohms from station No. 1 to station No. 2 is short. However, the distance from station No. 1 to the farthest point in the line is considerable and is enough to make satisfactory coordination of the relays and fuses difficult. Besides maintaining relay and fuse coordination it is desirable to clear heavy faults as soon as possible at station No. 1 to prevent disrupting the stability of the 70-kv. system. At station No. 2 the main transformer bank, tapped on the 35-kv. line through fuses, steps the voltage down to 2.3 kv. for local distribution. A step-up transformer bank is also tapped on the 2.3-kv. bus through fuses to step the voltage up to 6.9 kv. for rural distribution. The 6.9-kv. line is connected to the bus through an oil switch. Time over-current relays having instantaneous elements are connected to trip the oil switch. A reclosing relay is set to reclose the oil switch three times and lock out in case the fault condition persists. The over-current relays are set to be selective with a 25-amp. tin-link fuse on the line.



CONNECTION of over-current relays at station No. 1

It is considered that 0.5 second selectivity allowed for relays will permit a safety factor of 0.35 second and that 25 to 35 percent additional

[*Continued on page 122*]

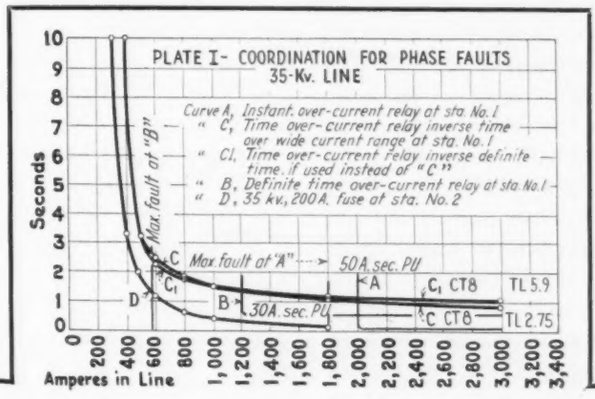


PLATE I- COORDINATION FOR PHASE FAULTS
35-Kv. LINE
Curve A, Instant. over-current relay at sta. No. 1
" C, Time over-current relay inverse time over wide current range at sta. No. 1
" C1, Time over-current relay inverse definite time, if used instead of "C"
" B, Definite time over-current relay at sta. No. 1
" D, 35 kv., 200 A. fuse at sta. No. 2
Max. fault at "B"
Max. fault at "A"
50 A. sec. PU
30 A. sec. PU
C1 CT8
C CT8
TL 5.9
TL 2.75
Seconds
Amperes in Line

CURVES show coordination between fuses and relays for different relay arrangements on 35-kv. and 6.9-kv. systems —Plate I, coordination for phase faults on 35-kv. line; Plate II, coordination for ground faults on 35-kv. line, and Plate III, coordination for phase faults on 6.9-kv. rural circuit

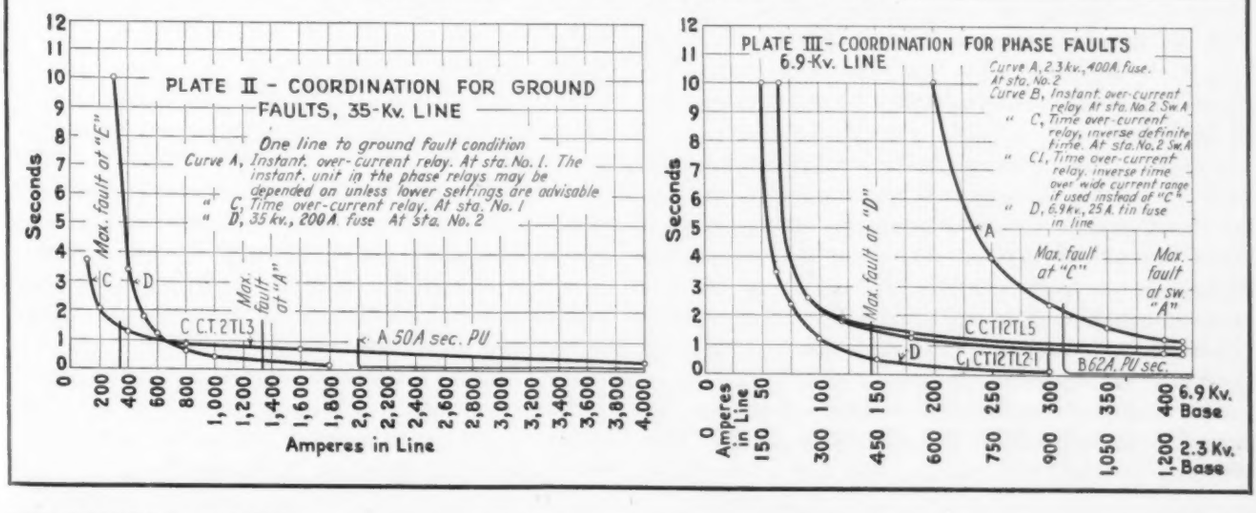


PLATE II - COORDINATION FOR GROUND FAULTS, 35-Kv. LINE
One line to ground fault condition
Curve A, Instant. over-current relay. At sta. No. 1. The instant. unit in the phase relays may be depended on unless lower settings are advisable
" C, Time over-current relay. At sta. No. 1
" D, 35 kv., 200 A. fuse At sta. No. 2
Max. fault at "E"
Max. fault at "A"
C C.T. 2 TL 3
A 50 A. sec. PU
Seconds
Amperes in Line
PLATE III- COORDINATION FOR PHASE FAULTS
6.9-Kv. LINE
Curve A, 2.3 kv., 400 A. fuse. At sta. No. 2
Curve B, Instant. over-current relay At sta. No. 2 Sw. A
" C, Time over-current relay, inverse definite time. At sta. No. 2 Sw. A
" C1, Time over-current relay, inverse time over wide current range if used instead of "C"
" D, 6.9 kv., 25 A. tin fuse in line
Max. fault at "D"
Max. fault at "C"
Max. fault at sw. "A"
C CT12TL5
C1 CT12TL21
B 62 A. PU sec.
Amperes in Line
6.9 Kv. Base
2.3 Kv. Base

Editorials

S. B. WILLIAMS, *Editor*

Prudent Investment Theory Invoked

"PRUDENT INVESTMENT," the pet valuation theory of the New Deal, has now passed from the stage of theory to that of fact. In spite of the refusal of the Supreme Court two years ago to substitute prudent investment for fair value as defined in Smythe vs. Ames, the Federal Power Commission invoked its use in the recent decision cutting the rates of the Chicago District Electric Generating Company (State Line).

This case is extremely important because if the decision is allowed to stand it marks the beginning of another long series of rate cases based upon the lower values which are expected to result from the operation of the prudent investment formula.

For some time the FPC has been collecting from utilities data on original cost. Since it took so long, three years, to make such a simple determination as the State Line case, the assumption is that this decision was held back until the commission had the greater part of the original cost data from all utility systems in hand. If that assumption holds water, then this case is but the prelude to a series of rate investigations in places where FPC has jurisdiction.

The substitution of original cost for reproduction new is urged by its supporters on the grounds of a one-time determination and greater simplicity. When one considers the great cost of some valuations and the time they took it would appear on the face of it that the above suggestions had merit. The argument in the State Line decision, however, discloses some of the perniciousness of the theory.

When reproduction new is invoked to determine fair value the testimony of experts is introduced by both sides, and if widely at variance some compromises may be made. When determining prudent investment the commission need not be handicapped by the evidence of experts. The books show what the property cost. All the commission has to do is to determine in its own mind whether the price paid was a prudent investment.

For instance, in building a station land may be secured at the then price to accommodate a possible later extension or larger coal storage. Was that a wise thing to do? Some commission, years later, with all of the hindsight, attempts to decide the wisdom of those decisions without any regard for conditions existing at time of purchase.

Facing as we are a period of inflation, it is obvious that the prudent investment theory presents to unfriendly regulation a weapon with which to pare down rates in spite of rising costs.

The question which faces the industry, therefore, is whether this theory will be accepted by the Supreme Court in the place of fair value. The last decision in which this point came up was decided in favor of Smythe vs. Ames by a New Deal court. Will it reverse itself?

How to Measure Relative Lightning Severity

ONE TROUBLESOME FACTOR about lightning data and experience is that there is no good index of the relative severity of lightning storms from season to season. In fact, the principal index now available is the relative amounts of fuse blowing, flashovers and transformer burnouts. As that is the very experience which one would like to correlate with extent, frequency and intensity of the lightning, we are confronted with a situation in which the result has to be the basis on which the magnitude of the cause is inferred.

Isokeraunic lines have been established as a topographical record for actual and typical lightning seasons. But these are based solely on number of storms and take no account of relative severities. Since it is well recognized that storms vary widely in their capacity to create electrical system disturbances, apparently what is needed is an additional measure of relative severities. Possibly the objective should be to extend the present observations so as to derive the aggregate of mega-amperes involved in the strokes, reduced to a square-mile basis. Still another possibility might be to deduce the kilocoulombs represented in the various earth-cloud images or even the absolute earth potential in the disturbed area. Perhaps some one can improve materially on the photographic summation which was used several years ago in the studies conducted on the Pennsylvania Power & Light Company's Wallenpaupack 220-kv. line. That improvised instrument had a small camera aperture and the cumulative exposure was taken as a measure of relative severities.

Though these are difficult to ascertain, hardly less phenomenal facts have already been pried out of nature's spectacular mystery. Nothing seems to daunt the lightning researchers. They seem to follow Nansen's aphorism that "the difficult is that which can be done immediately, the impossible is that which takes a little longer." Whenever we can add these "impossible" deductions to our present fund of knowledge we shall be in a position to analyze equipment and line performance still better and thus pave the way to strictly lightning-proof operation.

At least there is a challenge to continue lightning studies to the point where it will be less necessary to acknowledge inconsistencies in system and equipment performance records—inconsistencies that would melt away if we could record just a bit more about the relative viciousness of the disturbances.

The Trend Toward Contracting of Construction Work

FROM TIME TO TIME we have been asked if utilities were doing more or less of their own construction work and why. To get the answers we conducted a mail survey the results of which will be found in this issue.

The trend definitely is toward contracting the work and the reasons are what would be expected. Primarily, letting out construction work relieves the utility of the employment of temporary labor and of the responsibility to maintain employment of construction labor when work eases off.

During the past ten or twelve years construction was spotty and a company doing its own work had the choice of one of two evils. It could maintain a crew at considerable expense, even when there was not enough work, or it could hire new crews—untrained to the company's ways and not necessarily well skilled—whenever a job was started. An outside contractor could relieve the company of this problem.

While employment problems are of primary consideration, there is another side that should not be overlooked, especially if the prudent investment theory should gain ground, and that is the determination of original cost.

When a company does its own work a regulatory body can find fault with the cost of about every job. When a contractor is employed there is much less to question when arriving at the cost.

And particularly should this be true during the period of national emergency, when costs can be so uncertain. Extra costs are bound to arise which if incurred by the utility might be imprudent, yet be approved when charged by the contractor.

Extension of Army Service Time

BUSINESS faces another series of personnel problems in the extension of selective service time. On the original basis of one year for draftees, reserve officers and guardsmen, certain plans were set up for temporary replacement, extended insurance payment and other benefits, as well as additional compensation. If the time is extended to another year and a half, as is proposed, how many businesses can keep jobs for their employees in service?

People who have held jobs under temporary replacement appointments and done the work satisfactorily are much less likely to be shoved back when an old employee returns to his job. Moreover, an employee away from his work for 2½ years may have considerable difficulty picking up where he left off. To some companies it is not going to be easy to carry men on the payroll, to make up differences in pay, as well as carrying all the employment benefits. Particularly do all these conditions apply to the older men who have been inducted into service, men who had already made considerable progress in climbing the ladder of responsibility.

If and when it is decided that the men must stay in service for some time beyond the year as originally planned for, management should quickly decide what changes, if any, in personnel policy are required and let them be known.

There can be no question but what the decision of management generally will be to take employees back upon discharge and to try to find a place for them in the organization. To guarantee old jobs after a period considerably beyond one year is going to prove difficult. The sooner a decision is made the better, however, because the temporary replacements are entitled to know where they stand.

Dealer Relations Policies Under Reduced Production

WHAT EFFECT will the imminent curtailment of appliance sales have upon the dealer relations policy of utilities? Will more utilities cease direct sales of residential appliances in order to release more equipment to dealers so that they can stay in business, or will they have to take over a greater share of the sales because dealers have to fold up?

What effect, also, will such curtailment have upon the business of the specialty electrical dealer? Will utilities make a special effort to maintain them in business, and if they do will they have to be selective on the basis of merit? Obviously, the department and general stores will be better able to survive this emergency because of a greater variety of merchandise. Do the utilities want to entrust the dealer merchandising very largely to this type of outlet?

After a period of ten years or more of intensive activity in building up a program of dealer relations which has resulted in the major portion of the appliance sales being directed through dealer channels, the obvious thing is naturally to try to preserve as much of the set-up as possible.

Even if the utilities by throwing more of their sales to dealers are not able to prevent the closing up of a great many of the smaller places; the fact that they did everything possible to pull them through is bound to create a very favorable public opinion and a brand of dealer relations that will be very valuable when this emergency is over and utilities need load badly.

NEWS OF THE WEEK

More Capacity Scheduled in Raritan River Station

Jersey Central Power & Light will increase plant capacity from 45,000 kw. to 103,000 kw. by adding two Babcock & Wilcox boilers and a new 25,000-kw. General Electric topping turbine

Construction work now under way and planned for the Raritan River electric generating plant at Sayreville, N. J., of Jersey Central Power & Light Co. will increase the present capacity of 45,000 kw. to a total of 103,000 kw. by the end of 1943. Power loads for defense activity and normal customer growth have been anticipated and a plentiful supply of electricity will be available.

Planned Additions

The new construction now under way is a result of studies made in May, 1940, to forecast load conditions, according to William H. Baldwin, assistant to the president. Mr. Baldwin said that plans were then made for the installation of additional equipment in the plant this year.

At the time the Raritan River station was built by the Eastern New Jersey Power Co. it was intentionally underboilered. The plant as built consisted of two 30,000-kw. turbo-generators, or approximately 45,000 kw. Engineers recommended that boilers be purchased to utilize this excess of generating capacity and that later other equipment be installed to increase the station capacity. Their report recommended that the work be done in two steps, the first of which is now going forward. Contracts have been placed for the major equipment for the second step.

The first step, estimated to cost $928,000, consists of a boiler designed to operate initially at the present station pressure and temperature. The boiler, purchased from Babcock & Wilcox, is now being installed and will be in operation late this year. The station capacity will be increased 15,000 kw.

The second step, estimated to cost $2,200,000, consists of the installation of another Babcock & Wilcox boiler and a 25,000-kw. General Electric topping turbine, exhausting into the present station header. This topping turbine will further increase the capacity of the station by 25,000 kw. normal rating.

Mr. Baldwin pointed out that by the installation of the boiler provided for under the first step, the installation of the 25,000-kw. topping turbine and the adjustment of the wattless component the capacity of the station will be increased from the present 45,000 kw. to a total of 103,000 kw. by the end of 1943.

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Expansion of Steam Faster Than Hydro

Expansion by privately owned utility concerns that use steam-generating equipment will be faster and cheaper than enlargement of our government-owned hydro-electric facilities in meeting the power demands of the defense program, Representative George W. Johnson of West Virginia asserts.

Either method will impose heavy demands on industries manufacturing generating equipment, he points out, but in steam plants the equipment and the buildings are all that is needed.

In hydro-electric plants, dams and waterworks, which mean a large capital expense, more labor materials are necessary in addition to the installation of equipment. Also the time of completion is twice as great. Furthermore, Representative Johnson argues, the location of steam plants is more flexible, eliminating long-distance transmission problems.

The coal industry is asleep at the switch, says Representative Johnson, while hydro-electric groups are fully awake to our present need of low-cost generating capacity, and what they can do to meet it. Representative Johnson thinks that some generating equipment can be installed at the mouths of the mines, and hopes to arouse the coal industry to action in this direction.

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Nantahala Power Will Buy Utility System

Nantahala Power & Light Co. has been granted permission by the North Carolina Utilities Commission to purchase the holdings of the Smoky Mountains Power Co. The Smoky Mountains company's chief business is to supply electric energy for Bryson City under a lease through which it operates the town's generating plant.

It was stated that the Nantahala company will assume charge of the holdings on September 1. The holdings consist of the generating plant on Oconaluftee River, 5 miles east of Bryson City, and the distribution system.

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Rains Aid River Flow

The flow of the Connecticut River has been materially improved as a result of recent rains. The flow at Turners Falls gave an output to the plant equal to approximately 70 percent of its full capacity, following the rain. The rivers in Massachusetts and Connecticut had minor flashes, but are down to minimum summer levels.

NEWS BRIEFS

THE CIRCULATING WATER PUMP for the condenser of the 165,000-kw. machine at Philadelphia Electric's Richmond station pumps 99,000 gallons per minute—as much in one minute as a householder is allowed for a year on his $8 minimum water charge.

CLASSES IN ELECTRIC COOKING run by the home service department of Central Maine Power Co. in the season just closed drew 18,140 people into the fold for instruction. The western division broke first with 5,714 in attendance. This record attendance cost about 13 cents per person and the new-business department chalked up $135,169 in electric appliance sales in June, another record.

THE GROWING SCARCITY of farm labor is making easier sales talks for mechanization of farms, especially electrical equipment. The Electric Water Systems Council is going out for more business with promotional work intensified. High farm prices are giving the farmer more "cartwheels" to jingle in his jeans.

REPLIES from five public utilities to N.A.M. shows that the average per capita cost of medical program to be $4.83 and the ratio to average for all industries to be 0.93. Of four replies the average per capita cost of safety program was $2.56 and the ratio 0.77.

PROPOSALS TO CURTAIL production of consumer goods to make more facilities available for national defense has brought opposition from labor unions who view the situation as causing loss of employment. One CIO union opposes arbitrary reductions, suggests that reductions be offset by an equal volume of government orders and that laid off workers be given first call on jobs with other companies.

FIVE HIGH SCHOOL GRADUATES have been selected as 1941 winners of War Memorial Scholarships established by Westinghouse in honor of its 5,000 employees who served in World War I.

JEAN LOVEJOY, home service director of West Penn Power, has broke out in print as co-author, with *McCall's Magazine's* Kathleen Robertson, of an illustrated article on electric ranges. It appears in *McCall's* August issue.

PRIZES OF $25, $15, $10 went to three winners of the need for foreign trade contest conducted by Westinghouse. A total of 65 letters were submitted by employees and Joseph F. Mann, assistant industrial apparatus manager of the International company, took first prize. Carl A. Hergrueter was second and Phillip H. Scheller, third.

ADDS NEW CAPACITY—Steam plant at San Juan of Puerto Rico Railway, Light & Power Co., where a new 7,500-kw. Westinghouse turbo-generator is being put on the line to meet growing power load due to national defense activities and industrial growth

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Revise Service Rules for Wisconsin Utilities

Rules and regulations which for the past 23 years have guided Wisconsin utilities in furnishing electric service to customers have recently undergone a comprehensive revision at the hands of a 35-man group consisting of the Wisconsin Public Utility Commission staff, a committee of 24 private utility engineers and seven engineers from the Wisconsin municipal utilities.

The revised service rules were made public in a 65-page order of the Wisconsin commission. The order covers such subjects as quality of service, meter reading, billing maintenance and testing of equipment, handling of complaints, adjustment of errors, and other general standards. The new service standards will become effective September 1.

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Confirm Board Members

Missouri State Senate before final adjournment confirmed Gov. Forrest C. Donnell's appointments for three places on the state Public Service Commission, including his executive secretary, Frederick Stueck, St. Louis attorney, whom he designated to be chairman of the commission. The other new members are former Circuit Judge Paul Van Osdel of Bucklin, Mo., and Kyle D. Williams of Albany.

Utility in Puerto Rico Orders 7,500-Kw. Unit

Defense activities in Puerto Rico have greatly increased power loads of Puerto Rico Railway, Light & Power Co. of San Juan. Last year the company budgeted an estimated $500,000 on the installation of a Westinghouse 7,500-kw., 3,600-r.p.m. turbo-generator at its San Juan plant, which increased capacity approximately 60 percent. The unit was scheduled for operation this summer.

Ramon Noble, Jr., chief engineer, pointed out that government building of a naval ship and air base, as well as the construction of larger Army camps, added 20 percent annually to the electric load.

Mr. Noble pointed out that in the past six years the increase in load due to government construction, new industries and rural electrification on the island has been 49,000,000 kw.-hr. Last year total power production was 86,500,000 kw.-hr., as against 37,000,000 kw.-hr. in 1934. Efficiency of plant operation has been increased and distribution losses have been decreased from 28 percent in 1934 to around 12 percent.

The company recently placed an order for another 7,500-kw. Westinghouse unit to be installed in the San Juan plant. This turbo-generator will probably be in operation next year.

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Chile to Buy Utilities

The Chilean Government has decided to buy electric and traction companies in Chile, representing investments of about $80,000,000 by United States stockholders.

Lack of Materials Forces REA to Alter Line Plans

Normal schedules to be cut 50 percent as supplies are needed for defense purposes — OPACS and agency work out program of curtailment — Will complete projects now under way

The government's rural electrification program is joining automobiles, refrigerators and other consumers' goods in drastic curtailment of normal schedules to make way for defense.

The Civilian Allocation Division of OPACS has worked out with the Rural Electrification Administration a program contemplating nearly a 50 percent reduction in REA's line-building pace effective as soon as the agency's presently "booked" projects are completed. Construction currently is about five months behind allocations.

Supplies Available

To complete projects now under construction or for which funds have been earmarked, OPACS has directed OPM's Priorities Division to make available to REA suppliers 4,500 tons of copper, 3,100 tons of steel, 140 tons of zinc and 3½ tons of aluminum monthly for the six months beginning this month. This will permit construction at the rate of about 9,000 miles of distribution lines monthly, tapping an average of about 20,000 farms. This is roughly the pace at which REA has been building lines.

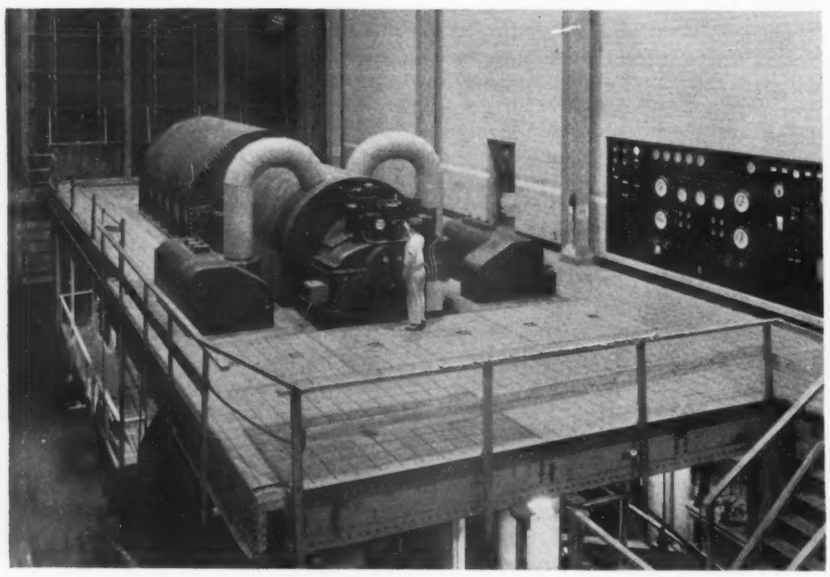
Effective at once, however, OPACS has warned that REA should reduce its projected rate of line growth nearly 50 percent, planning new construction at a rate which will electrify only 11,000 farms monthly—or about 5,000 miles of distribution lines. Implied, but not written into the OPACS program, is assurance that after January, 1942, a new allocation program cut to fit the reduced schedule will be promulgated.

The six-month allocation rates now in effect carry a stipulation that the materials must be used to complete work now in progress or for which funds have been made available. REA is not to undertake new work unless the amount of materials provided are available over and above that needed for projects now on the books. REA officials say the quantities of metal allocated by OPACS will permit some new work and this will be limited to projects in farm areas where electric power will stimulate the types of food needed for defense—chiefly milk and eggs.

Reduced Allocation

Also stipulated is that the amount of materials allocated shall be reduced each month by the quantities made available to REA for construction of defense projects and the quantities of aluminum which REA can save by arranging to charge for power at a flat rate per month, eliminating need for meters. Many REA projects now have flat charges for institutions and certain types of semi-public consumers.

This REA allocation program marks the first concrete policy developed by any defense agency toward new electric extensions. It is not considered, however, that this should be a precedent for the problem of channeling supplies to utilities for connecting new homes in presently served territories. No policy has been worked out for this field as yet and utilities unable to get needed materials to connect new homes can only apply for priority assistance to OPM on Form PD-1.



ON THE LINE—Last week Public Service Electric & Gas Co. of New Jersey placed this 50,000-kw. General Electric high-pressure turbo-generator in operation in the Marion station. A new 50,000-kw. low-pressure unit is being installed in the same station and will be in operation in the fall of 1942

N. J. Public Service Operates New Unit

Generating capacity available to meet growing defense power loads in the area served by Public Service Electric & Gas Co. of New Jersey was increased 50,000 kw. last week when the company put into operation the new high-pressure turbo-generator at the Marion station. The new General Electric unit increases the capacity of the company's electric system to 887,700 kw.

A low-pressure General Electric generator of 50,000 kw. capacity is now being installed at Marion to operate in conjunction with the high-pressure unit and will be in operation in the fall of 1942. By that time Marion will have increased its capacity to an extent equal to the 100,000 kw. put in operation at the company's Burlington station last November.

Now under construction at Burlington generating station is another 100,000-kw. unit, this one a Westinghouse unit scheduled for operation in the winter of 1942. The other unit was a General Electric machine. When the new 100,000-kw. unit is completed the capacity of Burlington will be 225,000 kw. and the total capacity of the Public Service system will be 1,037,000 kw.

By the winter of 1942 the company will have increased the capacity of its electric system since 1937 by 350,000 kw., or approximately 51 percent. In addition to the increased generating capacity the company has interconnections with neighboring utility companies.

FPC Probes Transmission of Power to Mexico

Federal Power Commission has instituted an investigation relating to the transmission of electric energy produced in the United States by the Central Power & Light Co. of Corpus

Christi, Tex., and transmitted to the Republic of Mexico through a metering point on the international boundary line at Hidalgo, Tex. In addition to Central Power & Light Co., the Compania Internacional Difusora de Reynosa, S. A., and Carr P. Collins and James Mitchell Collins (doing business under the style of Collins & Collins) are named as respondents.

The commission seeks to determine, among other things, whether the transmission of energy in question impairs the sufficiency of electric supply in the United States or impedes the co-ordination of electric facilities subject to commission jurisdiction.

Central Power & Light Co. has reported to the commission that it sold to the Mexican company 1,096,300 kw.-hr. of electric energy in 1939, last year 1,669,700 kw.-hr. and is now delivering energy at the Hidalgo metering point under existing contract.

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Consolidated Edison Starts New Campaign

With the end of the fourth combination bargain electrical appliance campaign on July 31, Consolidated Edison Co. of New York system immediately launched a fifth drive, which started this week and will run as long as manufacturers can continue to supply the customer demand.

E. F. Jeffe, vice-president, stated that the four-month drive just ended maintained the mark set by the three predecessor appliance bargain drives.

The appliances in the new drive include an Eureka deluxe tank-type vacuum cleaner, retail value $49.95, to be sold for $22.90 cash plus 46 cents New York City sales tax, or $2 down and $2 a month for eleven months, and a $12.50 Schick Flyer shaver, which can be bought by those who purchase the cleaner for $1, including city sales tax.

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Northern States Power to Build New Line

Northern States Power Co. (Wisconsin), has been authorized to construct an 11-mile transmission line between Genoa and De Soto, Wis., at a cost of $17,000, the state Public Service Commission announced last week.

The company now generates energy for its De Soto distribution system with gasoline and Diesel-driven generation. It proposes to discontinue the generating plant, build the transmission line to Genoa and connect with another line there.

New Unit to Add 37,500 Kw. to Indianapolis Supply

Indianapolis Power & Light makes ready to dedicate new General Electric turbo-generator this month — A second unit has been ordered for operation in June, 1943 — Part of $5,500,000 plan

Indianapolis Power & Light Co. is preparing to place in operation this month its new 37,500-kw. General Electric turbo-generator in its Harding Street plant. A second such unit has been ordered and is scheduled for delivery in June, 1943.

President H. T. Pritchard said that the pair of generating units and the boiler plant extension now under way represent a total expenditure of approximately $5,500,000 to provide for national defense requirements as well as for the city's future growth. About $2,000,000 additional is being spent this year by the company to expand and protect transmission and distribution systems and for various other work.

Orders Second Unit

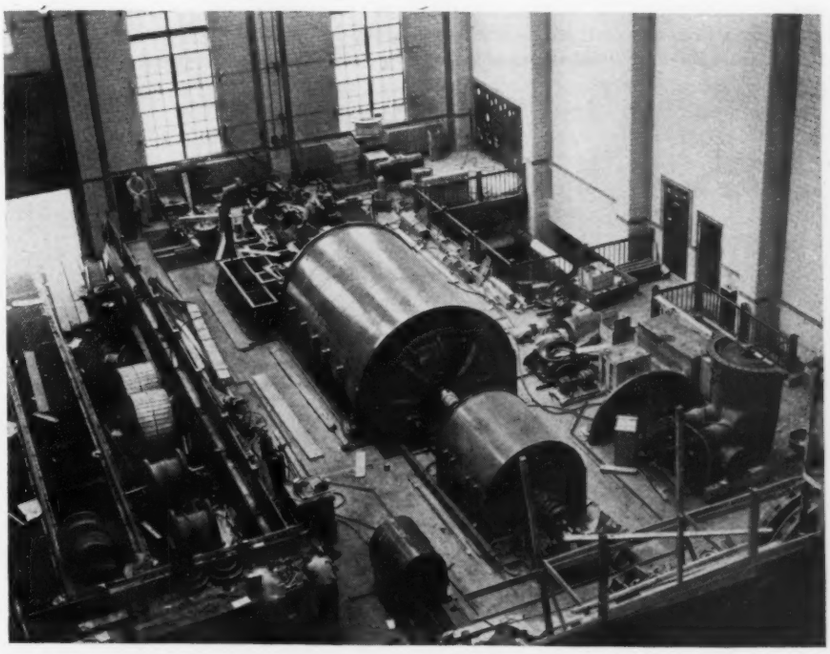
The second unit was ordered well ahead of the original schedule in the company's long-range development program to assure ample reserve power for local growth despite the abnormal increase in power needs for defense. It represents the fourth and final generating unit for which the Harding plant was designed. The first two units, which started operating late in 1931, have a rated capacity of 36,750 kw. each, and the addition of the two newest units will bring the total plant capacity up to 148,500 kw.

Final tests on the machine are being made and it is expected that the new unit will go into operation before the end of the month.

The company expects that about 17,000 kw. capacity will be made available when the machine is put on the line by operating it with excess steam from the present boilers in the station. The remaining 20,500 kw. of its capacity will materialize early next year when the new 400,000-lb.-per-hour boiler, for which the plant boiler room is now being extended, will be operating.

Foundation work for the boiler room extension has been completed and erection of steel for the walls has been scheduled. Delivery of the boiler is due to start in September.

The present turbine room is to be extended 101 feet more to the south for the fourth unit and construction of the extension is due to start by October, 1942.



GETTING READY TO RUN—This new 37,500-kw. General Electric turbo-generator is scheduled to be placed in operation this month by Indianapolis Power & Light Co. This view shows the unit being assembled in the Harding Street plant. A duplicate has been ordered for delivery in 1943 to be placed in an extension to the plant

Promotes Vast REA Public Power Pool for Arkansas

Would tie in government projects in three states and build two 90,000-kw. steam stations to supply power to proposed aluminum plant — Utilities propose plan to save money and materials

Electric power to supply needs of defense industries contemplated in Arkansas is being seized by Arkansas' Congressman Clyde T. Ellis and his colleagues to promote a vast REA public power network throughout Arkansas, Oklahoma and Texas to tie in government hydro projects.

The present maneuver started when OPM decided to put an aluminum plant of 100,000,000 lb. per year capacity in Arkansas at a cost of approximately $20,000,000. To get REA power to the aluminum plant would necessitate the expenditure of $40,000,000, including $20,000,000 for transmission lines and $20,000,000 for two 90,000-kw. each steam-electric generating plants in the "sour gas" fields.

Ellis Gets Backing

Congressman Ellis called the Arkansas members of the House together and got their signatures and that of Governor Adkins to a letter to OPM's William S. Knudsen, OPM's power division head, J. A. Krug, and to REA, recommending the REA plan and urging immediate and favorable consideration.

Big hitch in the public-ownership plan is the amount of strategic defense material needed to carry out the REA plan and the amount of public tax money needed to finance it. Arkansas Power & Light Co. has offered to supply power to the proposed aluminum plant and to effect a private-utility interconnection grid to insure adequate power requirements with a minimum of needed materials.

The following table shows a comparision of strategic materials required by the two proposed plans of supplying power to the aluminum plant:

Material	Arkansas Plan (193 Miles)	*REA Plan (2,076 Miles)	Additional Material Required by REA Plan (1,883 Miles)
Copper—lbs.	2,170,000	18,300,000	16,130,000
Galv. steel strand—lb.	334,000	4,490,000	4,156,000
Galv. hardware—lb.	320,000	1,414,000	1,094,000
Insulators	55,000	347,000	292,000
Poles	3,500	37,100	33,600
Arms	1,800	19,800	18,000

*Based on information contained in news releases.

Executive Vice-President C. S. Lynch of Arkansas Power & Light Co. says that strategic metals must be conserved to a maximum and tax funds devoted to production of vital items rather than diverted needlessly to duplicate present facilities if the national defense program is to succeed. Mr. Lynch said that the plan proposed by the private utilities would save 16,000,000 pounds of copper, 4,000,000 pounds of galvanized stranded wire, 1,000,000 pounds of galvanized hardware, 292,000 insulators, 33,600 poles and 18,000 crossarms.

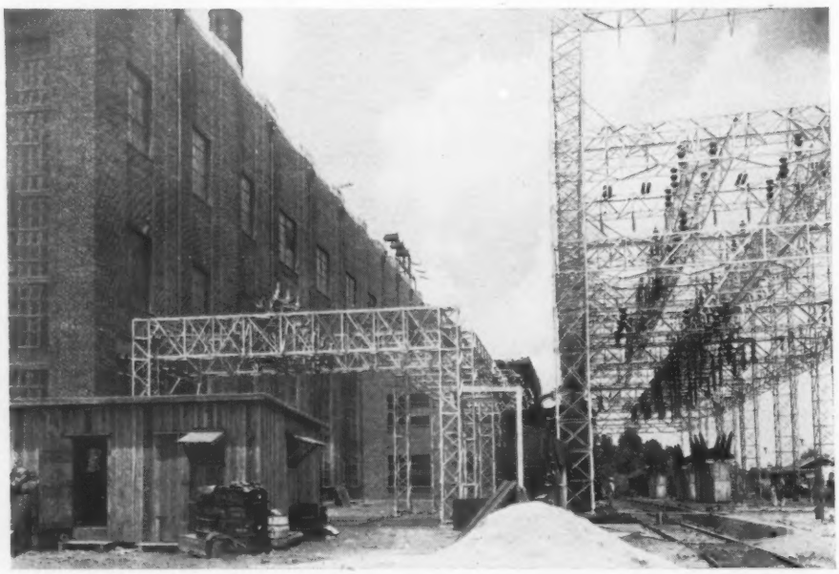
It was pointed out by Mr. Lynch that his company and interconnected systems in adjacent states have some extra capacity available and by building a few transmission lines power can be delivered at once to the new plant. So far the site for the aluminum plant has not been selected.

Sets Utility Pool

Mr. Lynch has written to Mr. Krug that the utilities can supply up to 65,000 kw. of emergency power. Interconnections would be made with Texas Power & Light, Southwestern Gas & Electric and Empire District Electric Co. Dallas Power & Light and Texas Electric Service Co. would also be brought into the system. Power would be supplied at a cost of 7.5 mills per kilowatt-hour.

As a further step to assure sufficient power for the aluminum plant the private utilities have proposed to Mr. Krug that they will install 125,000 kw. additional generating capacity. Arkansas Power & Light would add up to 75,000 kw., Louisiana Power & Light will install 25,000 kw. and Southwestern Gas & Electric would add 25,000 kw. of capacity. Mr. Lynch said that the companies are willing to design, construct and operate for government account, without profit, such facilities in a way similar to that now accorded other industries that are cooperating in the manufacture of war materials. Arkansas also proposed, as an alternate method, to design, construct and operate a 125,000-kw. plant for government account, without profit. Other alternative proposals have been made, but all seeking to have sufficient power available when the aluminum plant is placed in operation.

Main points for the private utilities are that more than $13,000,000 could be saved in addition to vast strategic materials, and that they could supply power sooner than it would take to carry out the REA plan.



NEW ADDITION—Exterior view of Plant Atkinson in Atlanta of Georgia Power Co., where work is nearing completion on the addition which houses the new 60,000-kw. General Electric turbo-generator. Scheduled for completion next November, work has been speeded to the point where the unit will go into service soon

Supervise Defense Plant

The Cities Service Co.'s new subsidiary, Cities Service Defense Corp., has been engaged by the War Department to supervise construction of the federal government's new $10,000,000 picric acid plant near Little Rock, Ark. Negotiations are under way for the new Cities Service subsidiary to operate the plant when completed. It will have a capacity of 75,000 lb. of picric acid per day.

MKB Display Prize Won by Ohio Edison

The Youngstown office of Ohio Edison Co. has won the Modern Kitchen Bureau's spring of 1941 electric water heater window display contest, with C. M. Griffin, display manager, receiving the first prize of $100.

Philadelphia Electric Co. won second prize with the display submitted by W. Gilbert Brown, supervisor of bureau of exhibits and displays, who won the cash award of $50.

Companies receiving third prizes included Buffalo Niagara Electric Corp., Niagara Falls, F. S. Wahl, Jr.; Electric Power Board of Chattanooga, Tenn., C. B. Osborne; Georgia Power Co., Atlanta, R. D. Benson; Gulf States Utilities Co., Beaumont, Texas, B. L. Pettie; Idaho Power Co., Boise, J. K. Newport; Knoxville (Tenn.) Electric Power & Water Board, C. P. Tombras; Minnesota Power & Light Co., Duluth, R. E. Anderson; Nebraska Power Co., Omaha, M. H. Rouse; Ohio Edison Co., Springfield, A. J. Plewes, and Ohio Power Co., Portsmouth, R. W. Moore.

The bureau's fall of 1941 electric water heater window display contest will offer another $250 in cash for winning displays.

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Carolina Officials Refute Charges

President Louis V. Sutton of the Carolina Power & Light Co. testified before the Federal Power Commission at a recent hearing in Raleigh, N. C., that a merger with other utilities in 1926 had proved "particularly valuable to national defense as well as to our customers."

Appearing as a witness during the commission's hearing into the company's plant evaluation, Mr. Sutton vigorously sought to show that the plant value of the company had not been "written up" nearly $24,000,000 in excess of proper figures as charged by the commission.

Mr. Sutton and other employees of the utility described service improvements and sharp rate reductions as having sprung from the 1926 integration. They claimed that by the end of 1941 the company will have made available a total of 652,000,000 kw-hr. of electrical energy for special defense purposes. "This could not have been done, however willing we might have been, if we had not made the integration," Mr. Sutton declared.

The utility president and H. B. Robinson, manager of the operating department, disclosed that the company had been supplying the Tennessee Valley Authority and the American Aluminum Co. plant at Badin with great amounts of power.

The company has been ordered to show cause why the item of $24,000,000 should not be placed in an adjustment account and written off, reducing its book evaluation to approximately $73,000,000.

The commission granted permission to the National Power & Light Co. to intervene in the case. National Power & Light alleged that recommended accounting adjustments, which would require Carolina Power & Light Co. to "dispose of $23,920,962.08 established in account 107, electric plant adjustment," would deprive National Power & Light Company of property without due process of law.

DISPLAY WINNER—The Youngstown office of Ohio Edison Co. won first prize for this attractive window display in the 1941 electric water heater window display contest conducted by the Modern Kitchen Bureau. C. M. Griffin, display manager, won $100

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Seeks Utility Purchase

Negotiations for the purchase of the Nebraska properties of Western Public Service Co. have been resumed by the Consumers Public Power District. Should these facilities be taken over by the public power system, Nebraska Power Co. will be the only private utility left operating in the state.

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Make Davis Dam Plans

Bureau of Reclamation is completing surveys and other work incidental to final plans for construction of the Davis Dam on the Colorado River, to be located about 67 miles downstream from Boulder Dam. Previously this project was designated the Bullshead Dam. Initial capacity is 180,000 kw. and the entire project is to cost $41,200,000.

Shea Cites Growth of Load on System

The existing and potential generating facilities of companies in the North American system in some instances have attracted so many defense operations to their areas that the demand for electric power has substantially exceeded previous estimates, President E. L. Shea states in a quarterly letter to stockholders.

Mr. Shea stated that for this reason it has been found necessary during the last quarter to order new plant facilities in addition to the large installations already authorized and under construction.

Since the beginning of 1940 the North American system has authorized an increase of 35 percent in generating capacity. This program involves the addition of 737,000 kw., including 90,000 kw. installed last year, 145,000 kw. for installation this year, 242,000 kw. for 1942 and 260,000 kw. for 1943.

•

Orders 5,000-Kw. Unit

Mayaguez Light, Power & Ice Co., Mayaguez, Puerto Rico, has ordered a 5,000-kw. General Electric turbo-generator for installation in its plant No. 2. The unit is scheduled for operation in June, 1942.

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Condemnation Suits

Condemnation suits have been filed to acquire the holdings of Puget Sound Power & Light Co. in Jefferson and Clallam counties. Bond issues of $350,000 for Clallam and $450,000 for Jefferson properties have been authorized.

MacFadden Elected Northwest Group Head

Sam P. MacFadden, vice-president of Puget Sound Power & Light Co., Seattle, was elected president of the Northwest Electric Light and Power Association at the recent annual meeting in Portland. He will serve one year, succeeding C. J. Strike, president Idaho Power Co., who held the office during the administrative year just closed.

J. A. Hale, vice-president Utah Power & Light Co., Salt Lake City, was named vice-president of the association at the same meeting. Vice-presidents for each state in the association territory were elected as follows: Idaho, R. S. Overstreet, Idaho Power Co.; Montana, M. E. Buck, Montana Power Co.; Oregon, James H. Polhemus, Portland General Electric Co.; Utah, W. A. Huckins, Utah Power & Light Co.; Washington, D. B. Leonard, Pacific Power & Light Co., and the province of British Columbia, W. C. Mainwaring, B. C. Electric Railway Co.

President MacFadden appointed Berkeley Snow, Portland, executive secretary and J. E. Anderson, Puget Sound Power & Light Co., Seattle, treasurer. He likewise appointed the following section chairmen for the year: Accounting and business practice, J. R. Thomas, Montana Power Co.; business development, D. J. McGonigle, Montana Power Co.; engineering and operation, M. T. Crawford, Puget Sound Power & Light Co.

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Transfer Plea Denied

New York Public Service Commission affirmed a previous order denying the Twin State Gas & Electric Co. permission to transfer its franchises, works and system in the village of Hoosick Falls and in the town of Hoosick, Rensselaer County, to the New York Power & Light Corp. on the ground that the price of approximately $600,000 agreed upon for the transfer was in excess of the value of the property and therefore not in the public interest. The company's original petition was denied by the commission last year.

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FPC Rescinds Order

The Federal Power Commission has rescinded its orders of February 1, 1941; June 2, 1941, and June 21, 1941, which authorized issuance of a license with special conditions for the proposed Cresta and Pulga power plants on the north fork of the Feather River to the Pacific Gas & Electric Co. The commission also dismissed the company's application for the license. The action was taken because the company found the terms of the FPC order unacceptable.

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Roosevelt Backs Projects

President Roosevelt has indicated that development of the Clarks Hill power project on the Savannah River, between South Carolina and Georgia, probably would be carried out by Army engineers. He indicated that the Lyles-Ford power proposal in South Carolina would be handled by the South Carolina Public Service Authority as an extension of the Santee-Cooper project.

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TVA to Widen Scope

TVA is to add to its domain as a result of the action of the Senate agricultural committee in approving legislation to include the entire Cumberland River basin within the TVA. It will add Kentucky and part of North Carolina and Virginia.

MEETINGS

International Association of Electrical Inspectors—Southwestern section, Hotel DeAnza, San Jose, Calif., August 25-27. H. L. Gerber, secretary, Room 205, City Hall, San Francisco, Calif., northwestern section, Winthrop Hotel, Tacoma, Wash., September 2-5. F. D. Weber, secretary, P. O. Box 70, Portland, Ore., western section, Hotel St. Paul, St. Paul, Minn., September 8-10. F. H. Moore, secretary, 320 N. Meridian St., Indianapolis, Ind.; eastern section, Mayflower Hotel, Washington, D. C., September 22-24. F. N. M. Squires, secretary, 85 John St., New York, N. Y.; southern section, McAllister Hotel, Miami, Fla., September 29-October 1. Joseph Whitner, secretary, P. O. Box 1743, Atlanta, Ga.

American Institute of Electrical Engineers—Pacific Coast convention, Yellowstone National Park, August 27-29. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

Pennsylvania Electric Association—Annual convention, Bedford Springs Hotel, Bedford Springs, Pa., September 3-5. A. B. Millar, managing director, State Street Bldg., Harrisburg, Pa.

Maryland Utilities Association—Mid-year convention, Ocean City, Md. September 5-6. W. Cook, secretary, Potomac Edison Co., Bldg., Frederick, Md.

American Chemical Society—Symposium on Electrical Insulation, sponsored by the committee on chemistry, National Research Council, Atlantic City, N. J., September 11. R. N. Evans, Consolidated Edison Co., 55 Johnson St., Brooklyn, N. Y.

Rocky Mountain Electrical League—Annual convention, Stanley Hotel, Estes Park, Colorado, September 11-13. George E. Lewis, manager, Gas and Electric Bldg., Denver, Colo.

Wisconsin Utilities Association—Accounting section, electric, gas and transportation. Lawsonia Hotel, Green Lake, Wis., September 12-13; electric section Hotel Schroeder, Milwaukee, October 13-14. A. F. Herwig, executive secretary, Room 502, Brumder Bldg., 135 West Wells St., Milwaukee, Wis.

Illuminating Engineering Society—Annual convention, Atlanta-Biltmore Hotel, Atlanta, Ga. September 22-25. Frank G. Horton, executive secretary, 51 Madison Av., New York, N. Y.

Association of Iron and Steel Engineers—Annual convention, Cleveland Public Auditorium, Cleveland, Ohio, September 23-26. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

Indiana Electric Association—Annual fall meeting, French Lick Springs Hotel, French Lick, Ind., September 24-26. R. E. Blossom, secretary, 1414 Circle Tower, Indianapolis, Ind.

Narragansett Electric to Build New Plant

President Samuel C. Moore of the Narragansett Electric Co., Providence, R. I., a New England Power Association subsidiary, announces the decision immediately to proceed with the construction of a new steam generating plant on tidewater at Westerly, R. I., to be completed by December, 1942, based on manufacturers' deliveries.

The initial installation will consist of two Allis-Chalmers 10,000-kw. (at 80 percent power-factor) turbo-generators, to operate at 650 lb. steam pressure and 825 deg. F. total temperature, condensing units. Suitable boiler capacity will be contracted for shortly. The new machines will be run at 3,600 r.p.m., generating three-phase energy at 11.5 kv., and the generators will be air-cooled. They will be housed in a brick building about 145 ft. long x 100 ft. wide.

Mr. Moore stated that the decision to build this plant, the company's first generating station to be located outside Providence, has been brought about by the growth of the power load of defense industries, including the U. S. Naval Air Base at Quonsett. Such a plant has been under consideration for some time, in view of the development of load in the South County section of Rhode Island.

The project supplements recent improvements in the southern portion of the New England Power System, which include a 40,000-kw. installation at the Manchester Street station of Narragansett in Providence, major construction at Franklin Square substation, betterments at South Street station, a 110-kv. oil-filled cable between Franklin Square and Admiral Street substation, and a 110-kv. overhead line between Woonsocket and Admiral Street, previously noted in ELECTRICAL WORLD.

•

Produce Power Cheaper

Declaring that the Grays Harbor PUD, Aberdeen, Wash., can produce power cheaper than it can purchase it from Bonneville, City Commissioner O. S. Morris has urged that a new turbine be added to the Electric Park system. The proposed unit would be 2,000 kw. capacity.

•

Will Serve Air Field

Washington Water Power Co. has concluded contracts for supplying electric service to Geiger Field. The contract calls for use of 2,000 kw. and provides for construction of 4 miles of 13,000-volt line from the company's new Sunset substation.

Weekly Output Rises 16.8% Over Year Ago

Energy production of the electric industry for the week ended August 2 was 3,226,141,000 kw.-hr., a gain of 16.8 percent over the same week last year, according to report of the Edison Electric Institute.

Power output for the week was 1.3 percent above the preceding week and 34.4 percent above the corresponding week of 1939. Indications are that the present uptrend will continue with only slight variations, including the dip due in the Labor Day week in September.

Output continued to expand in the different geographic regions, with the Rocky Mountain region showing a sharp drop percentagewise over last year, as compared with the preceding week. For the Pacific Coast the percentage should be higher—data under revision.

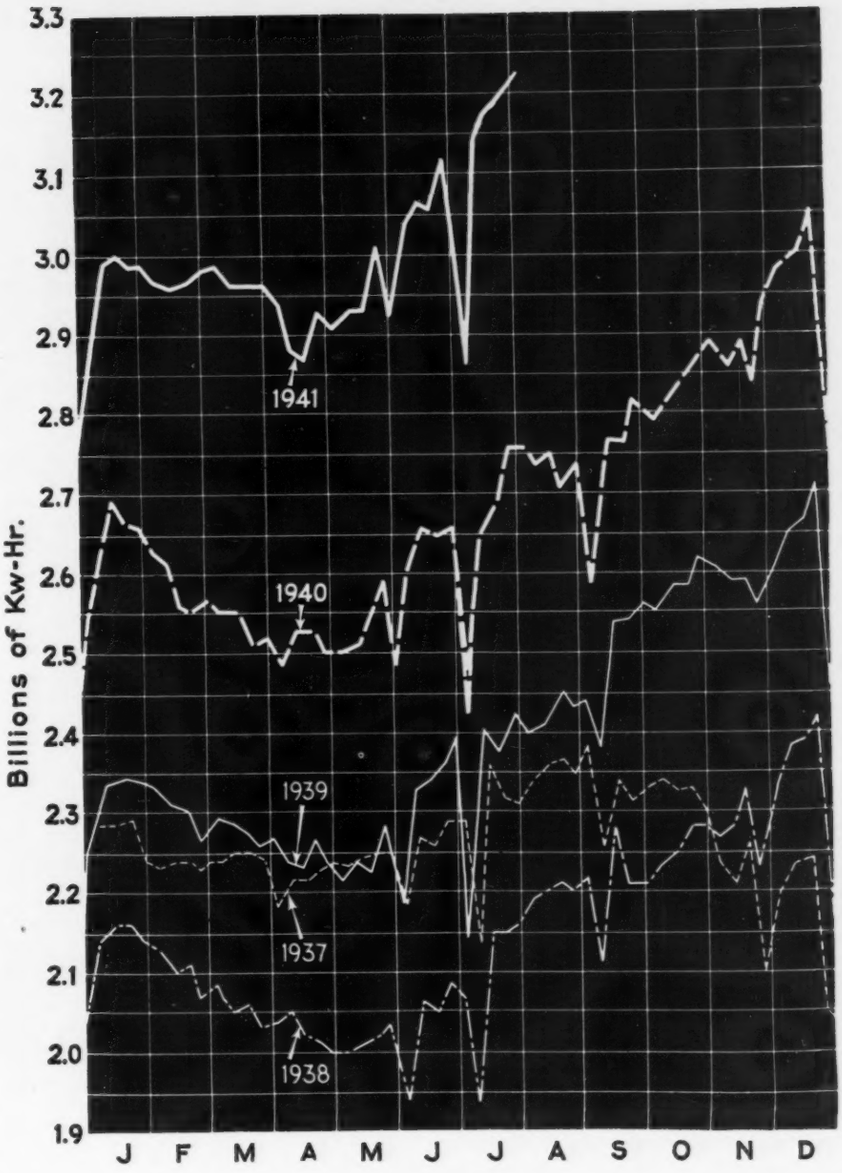
Weekly Output Millions Kw.-Hr.

1941		1940		1939	
Aug. 2	3,226	Aug. 3	2,762	Aug. 5	2,413
July 26	3,184	July 27	2,761	July 29	2,342
July 19	3,162	July 20	2,681	July 22	2,378
July 12	3,141	July 13	[illegible]	July 15	2,403
July 5	2,857*	July 6	2,425	July 8	2,145
June 28	3,121	June 29	2,660	July 1	2,396
June 21	3,056	June 22	2,654	June 24	2,362
June 14	3,05[illegible]*	June 15	2,665	June 17	2,340
June 7	3,042	June 8	2,599	June 10	2,329
May 31	2,[illegible]*	June 1	2,478	June 3	2,186
May 24	3,012	May 25	2,589	May 27	2,278

Per Cent Change from Previous Week

	Week Ending		
	Aug. 2	July 26	July 19
New England	+22.9	+22.3	+21.6
Mid-Atlantic	+16.9	+12.8	+17.2
Central Industrial	+21.7	+19.2	+22.8
West Central	+14.6	+10.5	+11.5
Southern States	+16.4	+16.2	+19.7
Rocky Mountain	+ 5.4	+10.3	+11.3
Pacific Coast	+ 8.3†	+ 9.8	+ 9.1
Total United States	+16.8	+15.3	+18.0

* Revised.
† Percentage should be higher—data under revision.



Power Output Up 19% During June

The total stock of coal on hand at electric utility power plants on July 1 was 11,198,225 tons, an increase of 10.1 percent, according to report of the Federal Power Commission. The total included 9,987,740 tons of bituminous and 1,210,485 tons of anthracite. The utility plant consumed approximately 5,376,603 tons of coal in June.

Total production of electric energy for public use during June was 13,432,475,000 kw.-hr., of which 4,034,037,000 kw.-hr., or 30 percent, was represented by water power. The average daily production was 447,749,000 kw.-hr., an increase of 3.8 percent over the average daily in May and an increase of 18.7 percent over June, 1940.

Reports received by the commission indicated that the capacity of generating plants in service in the United States on June 30, totaled 42,435,863 kw., an increase of 213,697 kw. over the preceding month.

It was reported that 2,595,863,000 kw.-hr., or 19.3 percent, of total generation of power in June was reported as crossing state lines.

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Utility Head Questions Jurisdiction of FPC

In commenting on the decision of the Federal Power Commission with respect to the rate base of the Chicago District Electric Generating Corp., Ralph H. James, president of the corporation, questioned the jurisdiction of the Federal Power Commission in the case.

Mr. James said the company's power contracts have been passed upon by the Illinois and Indiana Public Service Commissions and that the federal power act provides only for regulation of matters not subject to state control. He said that the reduction ordered apparently was arrived at on the basis of rate-making principles which, so far as he knew, have not received judicial approval.

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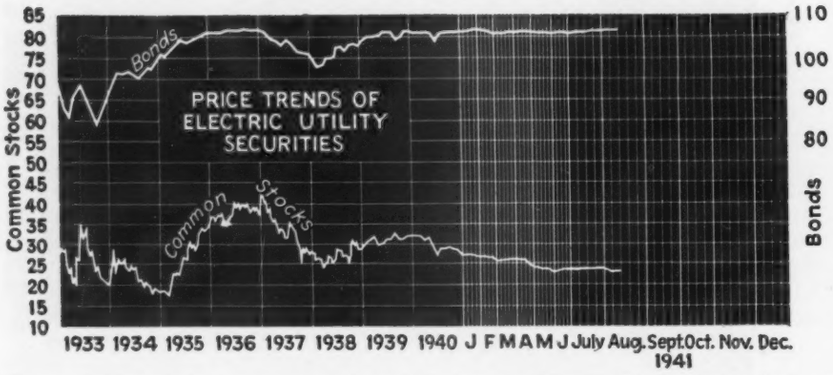
Asks for Complaints

Bill Watson, attorney who has been appointed consumers' counsel under New Mexico's new public service commission set-up, is asking the people of the state to send in their complaints. The new law is a lot stronger than people think, he declared, and he expects to do something about "rates that are higher than they should be" and complaints of individuals about inaccurate charges.

Utility Stocks Lower; Bonds Hold Firm


PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
65 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1933 1934 1935 1936 1937 1938 1939 1940 J F M A M J July Aug. Sept Oct. Nov. Dec.
1941

Prices of electric light and power stocks continued on the downward trend during the past week. "Electrical World" stock index dropped to 23.8 from 24.0 the preceding week; last year, 29.2. Bonds remained unchanged at 105.7, last year, 105.6

Cities Service Co. to Drop Utilities

Cities Service Co. has taken steps to comply with the integration provisions of the Public Utility Holding Company Act by filing with the Securities and Exchange Commission a plan calling for a complete divestment of its extensive utility holdings. Under the plan, the preferred stock would be retired and the company would limit its future business activities to the petroleum field.

It is proposed further than the principal electric light and properties of the Cities Service Co. be grouped according to location of operations and transferred to three new regional corporations. The stocks of these three corporations will be offered to holders of Cities Service preferred issues in exchange for their present holdings.

The three new regional utility companies are called the Rocky Mountain Regional Corp., the Ohio Regional Corp. and the Mid-Continent Regional Corp.

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Edison Cuts Dividend; High Taxes Blamed

Floyd L. Carlisle, chairman of the board of Consolidated Edison Co. of New York, recently notified stockholders that the quarterly dividend on the common stock had been reduced to 40 cents from the 50 cents paid previously.

In explaining the dividend cut, Mr. Carlisle attributed it to the sharp increase in taxes.

"Revenues from the sales of our service," Mr. Carlisle said, "showed an increase for the first six months of this year of $728,000, but our taxes increased $2,590,000. We are accruing federal income taxes for 1941 at a 30 percent rate. This, together with increases in certain other taxes, will raise our tax load for the year to $62,000,000, up $4,000,000 over 1940."

The dividend is payable on September 15 to stockholders of record of August 8.

•

Files $33,000,000 Issues with SEC

Wisconsin Power & Light Co. in a petition filed with the Securities and Exchange Commission seeks approval of the issue of $30,000,000 first mortgage bonds, series A, due on August 1, 1971, and $3,000,000 of 2¼ percent, 2¾ and 3 percent unsecured notes, due serially on February 1, 1942, and August 1, 1942.

An offering of the bonds to the public will be made by the participating underwriters following award under the competitive bidding code. The utility will sell $337,500 of 2¼ percent notes and $162,500 of 2¾s to the Continental Illinois National Bank & Trust Co. of the 3 percent notes the $2,500,000 principal amount is to be sold to the Northwestern Mutual Life Insurance Co.

Proceeds from this financing, along with other funds, will be applied to the redemption of $33,000,000 principal amount of 4 percent first mortgage bonds, series A, due on June 1, 1966.

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Seeks to Acquire Stock

Electric Power & Light Corp. has filed an application with the Securities and Exchange Commission under the public utility act regarding the proposed acquisition of the common stock of its subsidiary, Dallas Railway & Terminal Co.

U.G.I. Must Dispose of Thirteen Units

United Gas Improvement Co. has been ordered by the Securities and Exchange Commission to dispose of its holdings in thirteen companies in order to comply with Section 11(B)(1). The companies involved are engaged in the ice, ice cream, cold storage, railroad-car icing and real estate business.

The SEC asserted that U.G.I. failed to show the non-utility operations involved in the present proceeding have "any substantial relationship whatsoever, by proximity or otherwise, to any utility operations of the system."

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Northern States Power to Absorb Three Units

Northern States Power Co. of Minnesota has been authorized by the Securities and Exchange Commission to acquire and merge with its properties all the properties of three subsidiary companies. Securities of the subsidiaries, none of which are owned publicly, will be canceled and Northern States will be the surviving company.

Companies to be absorbed into Northern States are that company's wholly owned subsidiary, Minneapolis General Electric Co., and two wholly owned subsidiaries of the latter, St. Croix Falls Minnesota Improvement Co. and Minnesota Brush Electric Co.

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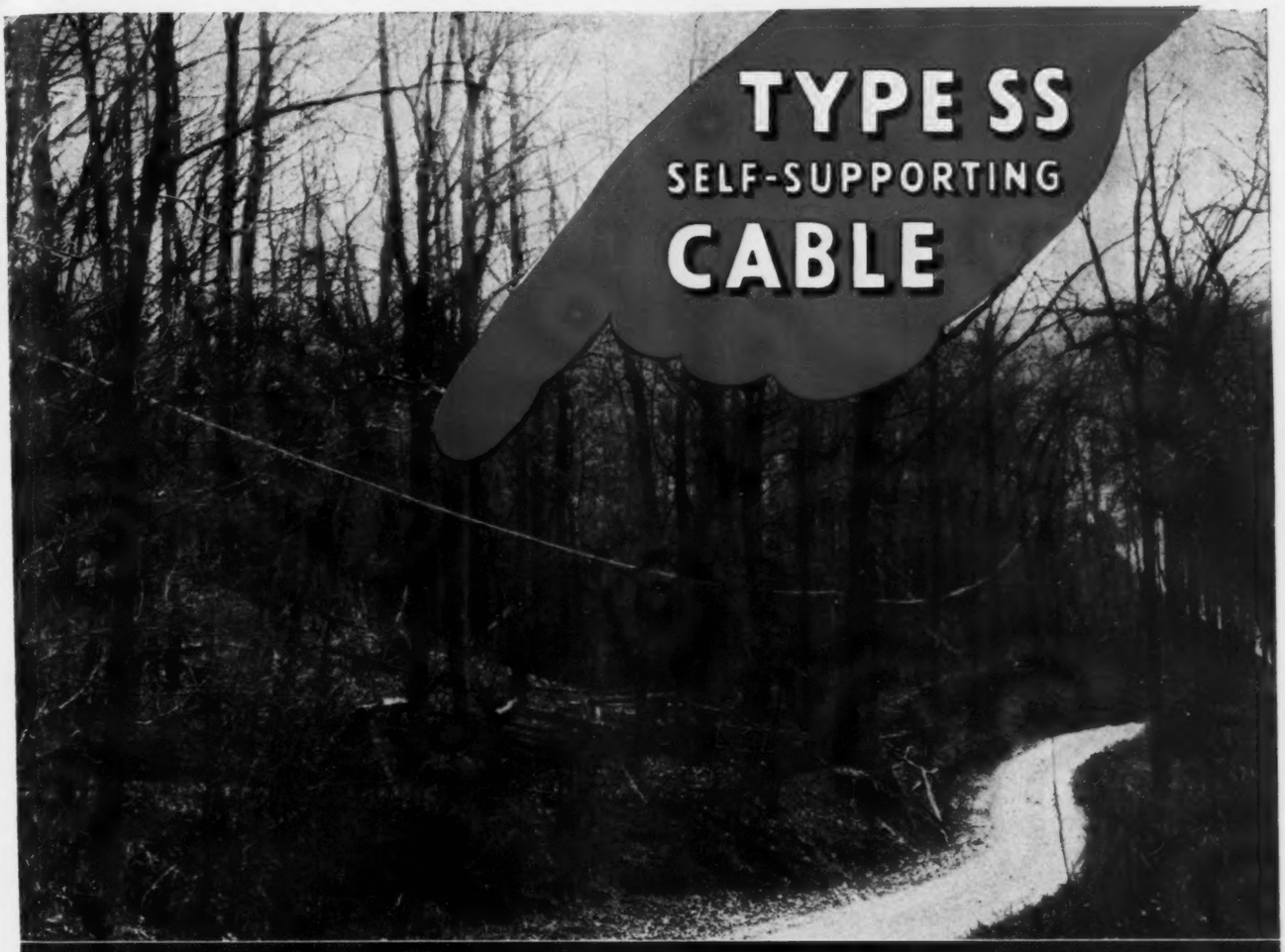
Weighs Refunding Plan

Proposals for refunding the entire funded debt and bank loans of the Long Island Lighting Co. are under consideration and will be filed soon with the New York Public Service Commission, it was recently reported.

Utility Reports

	Net Income 1941	1940
*Buffalo, Niagara & Eastern Pwr. and subs.	$8,288,728	$7,440,174
*Central N. Y. Power and sub.	3,150,619	2,326,980
*Commonwealth & Southern and subs.	14,317,962	13,443,299
*Consol. Gas, Elec. Lt. & Pwr. (Baltimore)	6,125,777	6,865,989
†Electric Power & Light and subs.	5,435,140	6,103,802
*Louisiana Power & Light	1,063,546	1,095,083
*New Orleans Pub. Serv.	2,502,145	2,653,973
*N. Y. Power & Light	3,553,933	2,757,582
*Niagara Hudson Power and subs.	16,799,752	14,591,770
*Public Serv. Corp. (N. J.) and subs.	22,861,191	25,563,222
*Southern Calif. Edison	12,349,422	12,502,732
*Utah Power & Light and subs.	1,972,377	1,612,835
*Wisconsin Public Serv. and sub.	1,814,218	1,793,560

*Twelve months ended June 30.
†Twelve months ended March 31.



IN PLACES LIKE THIS SS CAN SAVE YOU MONEY

NOW... MORE THAN 500,000 Feet in Service

TO construct open-wire or messenger-wire lines through territory like this would be difficult, impossible, or expensive—because of restrictions on tree trimming, or because of the higher cost of installing messenger-wire cable.

Type SS aerial cable made this 5-mile extension possible. The cable is suspended in long spans on 25-foot, class 7 poles—comparatively short, low-cost poles.

5 WAYS TYPE SS SAVES

High tensile and dielectric strength protects against service failure. The outer covering is formed of galvanized-steel wires interlocked with the outer conductors—a strong and flexible support.

Freedom from short circuits even if in contact with earth, trees, or other wires—thus practically eliminating the danger of death or injury by shock.

Better voltage regulation than with open-wire construction, because the ground conductor is of low resistance and low impedance, and is close to the other conductor.

Easily installed without the need for crossarms, pins, or insulators. Can be installed on existing poles with little or no possibility of interference.

Less lightning interruption if exposed wiring elsewhere is eliminated from the system. This is made possible by the ground wire in the outer cover.

In the past few years, more than 500,000 feet of this cable have been put into service. If you would like to know about the sizes available, prices, or other information, consult our local representative. General Electric, Schenectady, N. Y.

3 TYPES AVAILABLE

TWO-CONDUCTOR
For single-phase circuits with one side grounded

FOUR-CONDUCTOR
For three-phase, four-wire circuits

MULTIPLE-CONDUCTOR
For control and communication circuits

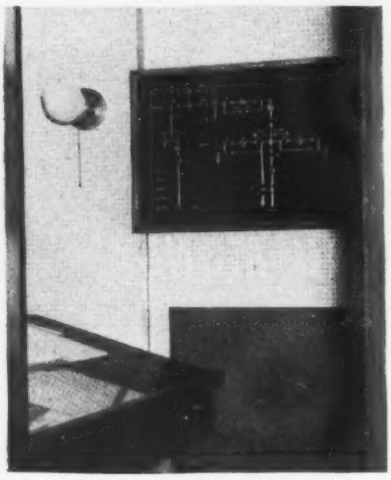
GENERAL ELECTRIC

501-Z-1200

OPERATING PRACTICES

Pilot Switchboard in Plant Phone Booth

A pilot switchboard has been set up in the telephone compartment at the Cheyenne, Wyo., power plant for the convenience and guidance of operators responsible for switching operations between the Cheyenne Light, Fuel & Power Company and the nearby substation of an interconnected organization.



PILOT SWITCHBOARD in phone booth provides visual minute-to-minute picture of progress of switching operations between interconnected systems

Function of the board is to avoid confusion that could arise from interruption during executing and "writing up" of a complicated switching operation. As the order for each operation is given and a report received of its execution the move is duplicated on the board's dummy switches. In this way the operator has before him at all times during the operations a picture of minute-to-minute system conditions.

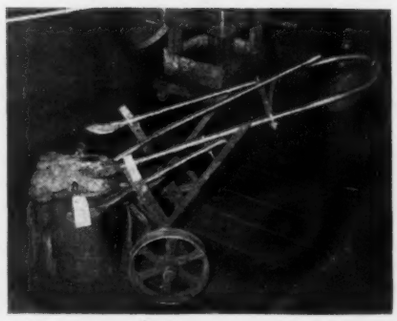
Miniature toggle switches—representing breakers—operate keyed red and green indicating lights at the side of the board to show breakers that are closed and open. Miniature single-pole, single-throw switches represent disconnects.

Actual operation of all circuit breakers on the interconnected system is done by remote control by the Cheyenne operator. Only disconnect switches are operated by the interconnected organization.

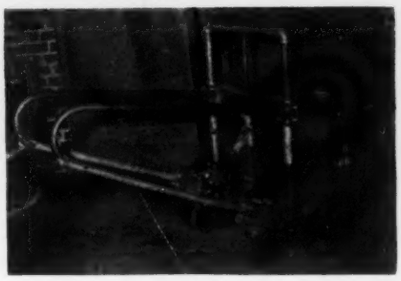
•

Transformer Carts Make Handling Easy

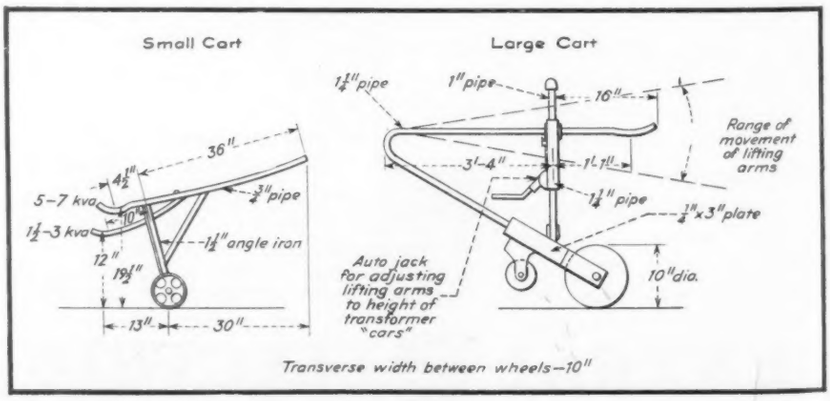
The lift and tug has been taken out of transformer handling operations at the storeroom of the Nebraska Power Company, Omaha, by the carts shown. Smaller of the two carts handles up to 7½ kva. transformers, the larger from 7½ to 15 kva. (cast-iron case) or 50 kva. (sheet-metal case). Different methods have been provided for adjusting the carts to various transformer heights. In the smaller of the carts separate lifting arms have been provided for the range of transformers from 1½ to 3 kva. and 5 to 7 kva. In the larger unit the adjustment is made by raising and lowering the lift-



Small cart, provided with separate lifting arms, facilitates handling various sizes of transformers up to 7½ kva.



Large cart can handle transformers up to 50 kva., by vertical adjustment of lifting arms and horizontal adjustment of cart handles.



DIMENSIONS of both types of transformer carts

NOW I WON'T HAVE TO CALL YOU EVERY TIME THERE'S A SHORT OR OVERLOAD.
THAT'S RIGHT! JUST TURN THE HANDLE AND THE POWER'S BACK ON YOUR MACHINE.
GENERAL ELECTRIC
AIR CIRCUIT BREAKER

Here's Why YOU'LL Like This New G-E Removable Breaker

WITH this *3-minute* breaker you can re-establish service after temporary faults in less than *one* minute. You can remove and inspect the breaker unit—in safety, away from live parts—in less than *two* minutes. And where load conditions have changed, you can interchange breaker units in less than *three* minutes.

This air circuit breaker is built to meet today's demands for quick installation and provide dependable protection for defense production lines. Its new features include a simple, ingenious method of mounting and a convenient modernized enclosing case, which combine to give you a removable dustproof breaker that is easy to install, easy to operate, and easy to inspect.

Give your production, equipment, and personnel complete protection. Install these breakers in lighting, power, and motor circuits—up to 600 volts. They will protect both the circuit wiring and the apparatus connected to the circuit. A new pictorial booklet (GEA-3600) tells where and how to use them. For a copy, write the G-E office nearest you, or address General Electric Co., Schenectady, New York.

GENERAL ELECTRIC

860-21-7500

THE BREAKER WITH THE DISCONNECT FEATURE

ing arms with an ordinary automobile jack. In addition to the vertical adjustment provided, the separate handles of the larger unit are pivoted about a vertical axis so they can be swung in or out to compensate for different width of transformers.

•

Distribution System for Camp Livingston

Electric service for the distribution system of Camp Livingston, near Alexandria, La., is derived from a 110-kv. transmission line that terminates in a 10,000-kva. 110/34.5-kv. substation of the Louisiana Power & Light Company near the Camp's east boundary. This substation is also tied into the 34.5-kv. transmission system of the Louisiana Ice & Electric Company, serving nearby Camp Claiborne.

From the outlying substation the government has built a 1½-mile, 34.5-kv. line to a 5,000-kva. substation at Camp Livingston's geographical center. Here voltage is stepped down in a bank of four (one spare) 1,667-kva. transformers for distribution throughout the camp at 4,160 volts. A 34.5-kv. emergency tie line also connects this government substation with the Louisiana Ice & Electric Company's 34.5-kv. lines south of the camp.

The government substation contains two 400-amp. feeder oil circuit breakers with reclosing, overload and ground fault relays and has an auxiliary bus arrangement that permits either or both feeder breakers to be removed from service without interrupting service.

Each feeder breaker supplies one of the camp's two unregulated 4,160-2,400-volt, three-phase, four-wire radial Y feeder circuits. Provision has been made for increasing the substation capacity 100 percent and adding breakers for feeder circuits on either end of the station.

There are 180 kva. of 2,400-volt pole type capacitors on each of the two main camp feeder circuits. The entire distribution system contains 100,000 ft. of primary and 200,000 ft. of secondary lines and there are 240 distribution transformers. This system compares with a distribution system adequate to serve a city of 33,000 population. Camp capacity is 40,000 men.

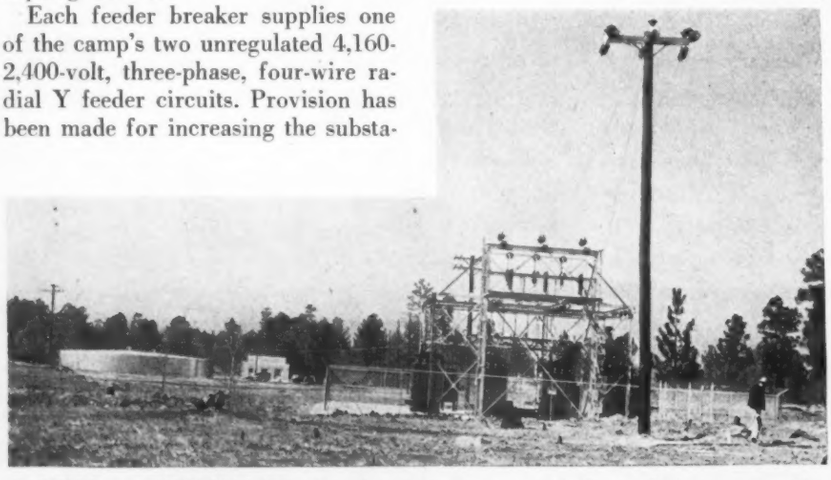
With the single exception of the water pumping motors, which are served 480 volts, three phase, other principal motor loads are 240 volts, three phase. Largest motor in the camp is 200 hp.

Total connected load for water pumping is 500 hp., there being 22 deep well pumps of 20 to 30 hp. each. The service pumps carry auxiliary internal combustion engines.

The 800-odd buildings in the camp are served single phase, three wire, 120-240 volts. Water pumping station, laundry and cold storage plant are served by primary underground wire with transformer vaults in each building.

Approximately 370 4,000-lumen series street lights (one at each street intersection) are in the system, which contains 175,000 ft. of series circuit. The street-lighting system is divided into eight circuits, each provided with a 15-kva. constant current regulator controlled by an astronomical time switch.

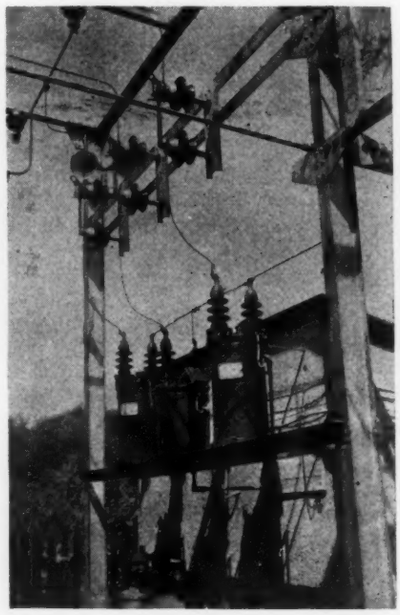
Estimated cost of the electrical systems for Camp Livingston exceeds $400,000.



A 5,000-kva., 34.5/4,160-2,400-volt substation at center of Camp Livingston supplies two principal distribution feeders servicing this 40,000-man army camp

Simple Mounting for "Pot" Transformers

Extreme simplicity of design in the modernization of an Eastern utility substation enabled the company to economize in the use of material while obtaining the benefit of clearances necessary for 22-kv. operation. In the new arrangement the potential transformers were mounted on two



DIRECT connections with bus and meter house save material

4-in. angle-irons about 10 ft. long with their high-voltage line terminals slightly offset below the disconnecting switches, from which short taps were run from the buses above.

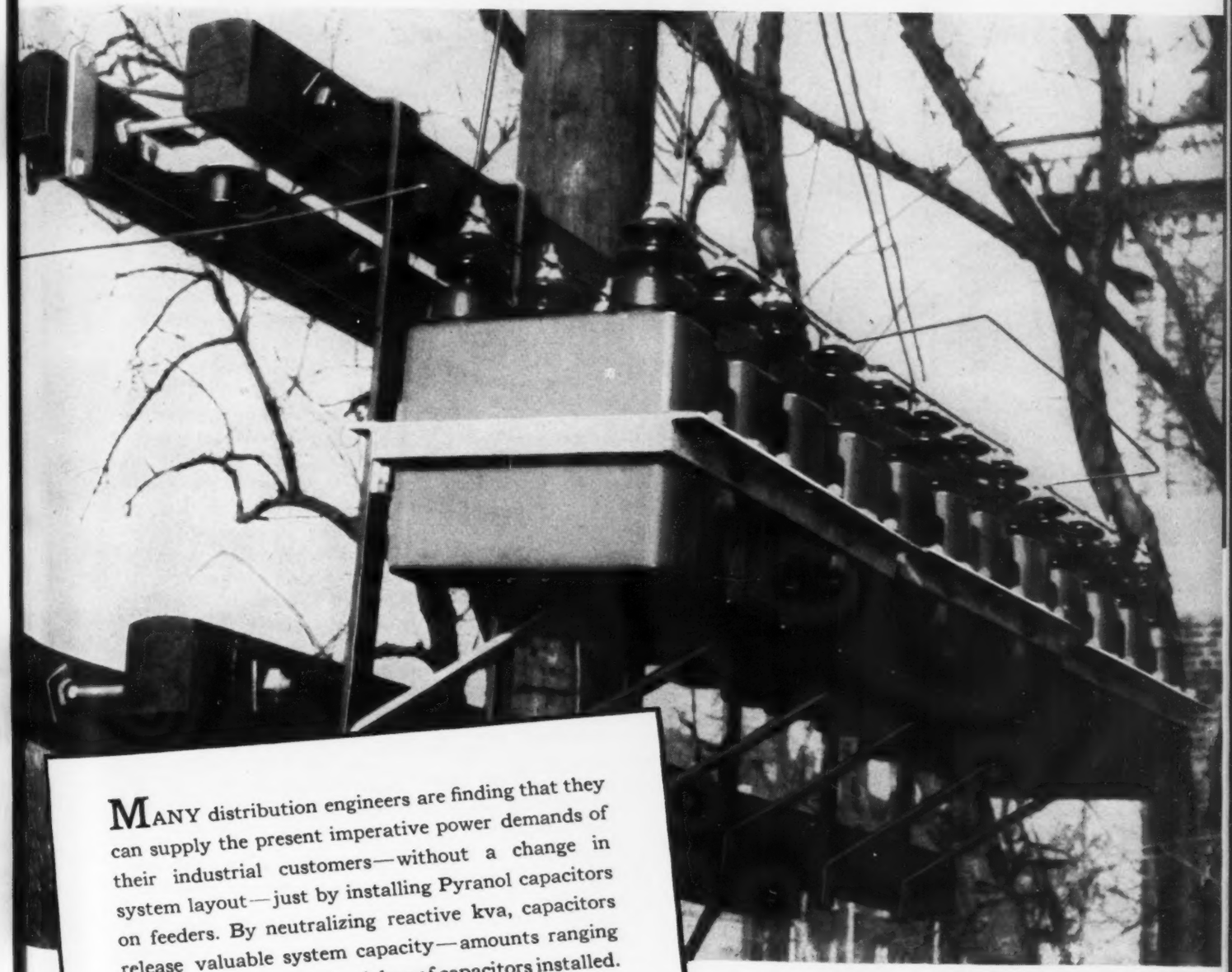
To ground a Y-connected layout by a short neutral a horizontal conductor was run from terminal to terminal on the "pots" to end at one of the 8-in. vertical columns of I-beam section which support the corner of the bus structure as well as the angles above mentioned.

The secondary connections from the "pots" to the relay equipment in the metering house were carried into the building by ¾-in. conduit which is run down the sides of the transformer tanks to a main tap through the wall, leaving the space clear around the units.

Disconnects were mounted on pin-type line insulators set with axes horizontal, facilitating switch-stick operation, the assembly being carried on steel bars riveted to the columns:

Quickest Way TO PROVIDE

FOR MORE LOAD ON YOUR SYSTEM—AT LOWEST COST, TOO!



MANY distribution engineers are finding that they can supply the present imperative power demands of their industrial customers—without a change in system layout—just by installing Pyranol capacitors on feeders. By neutralizing reactive kva, capacitors release valuable system capacity—amounts ranging from 1/3 to 2/3 kva for each kva of capacitors installed.

Cost? Very low in terms of what they accomplish—on many actual feeders, $7 per kva installed. Get details from our local representative, Ask for Bulletin GEA-3333. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

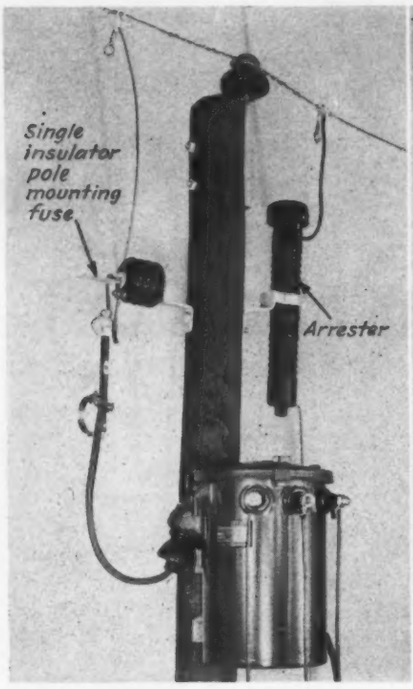


FIG. 1—Single-insulator pole mounting fuse for rural lines

For side tension, full side tension and dead-end construction the fuse is installed approximately the same distance from the phase wire and at right angle to the line. The base of the fuse is not grounded.

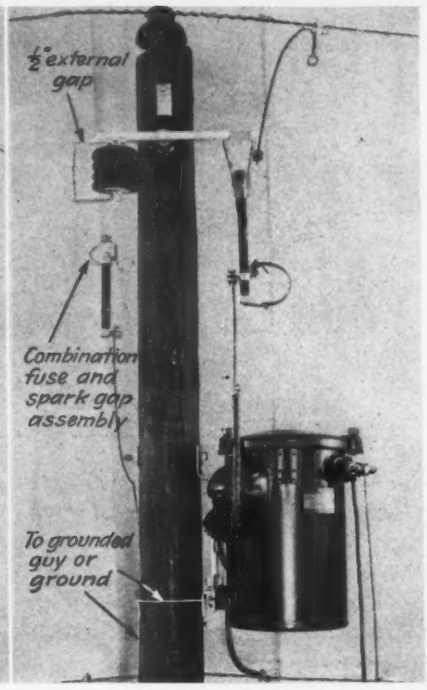


FIG. 2—Combination fuse and spark gap assembly on 6,700-volt single-phase rural ridge-pin lines

If pole space is available the device may be mounted on the pole below the ridge-pin support to facilitate installation or removal without disturbing the phase wire or the ridge-pin support. Mounted on side of pole of nearest primary bushing of single-bushing transformers; for clearance purposes the transformer may be rotated.

the offset angle of the primary terminal taps also aids dispersal of rain water away from the "pot" terminals.

•

Fuse and Gap Assembly Safeguard Rural Lines

By J. G. CHAREST
Superintendent of Distribution
Pennsylvania Power & Light Company

To cost less than the conventional type of cutout in use on urban lines and to give performance superior to practically all types of low-priced cutouts offered for rural lines the operating department of the Pennsylvania Power & Light Company has developed and applied a 15-kv., 50-amp. cutout (Fig. 1). The operating record of some 5,000 installed during the past five years shows that practically all the difficulties experienced with other low-cost types have been eliminated and there have been no failures. The former shortcomings comprised radio interference, mechanical failure of clamps, hazards to linemen, injury to line conductor where operated frequently, difficulty in connecting and disconnecting and the necessity of providing a special fuse link not standard for cutouts used elsewhere on the system.

A lightning arrester is used with the cutout for transformer protection. The cutout is made by the Line Material Company, which co-operated in the development. It costs 60 per cent less than conventional urban types.

Very satisfactory results with this cutout provided the incentive to reduce rural line costs still further by development and adoption of a combination fuse and spark-gap assembly (Fig. 2), which embodies the essential features of the plain cutout with an open gap and expulsion gap added. This combination will also cost about 60 per cent less than the conventional fuse cutout and standard lightning arrester.

Application of both devices is confined to single-phase ridge-pin rural lines with phase wire and grounded neutral. The supporting bracket is not grounded.

Consideration is now being given to a modification which will eliminate one of the insulators and thus further reduce weight, cost and breakable parts.

•

How Soil Resistivity Affects Grounding

By J. R. EATON*
Purdue University, Lafayette, Ind.

It has been observed that apparently similar samples of soil from different locations will vary in resistivity by a factor of 200 or 300 percent. Thus it becomes apparent that the problem of grounding is one intimately associated with the particular type of soil in which the ground connection must be made.

As indicated by the accompanying table, soils of different composition also have widely different values of specific resistance. The resistance figures are based on data on the measured value of ground resistance in widely separated parts of the United States as reported by the Bureau of Standards, without regard to temperature or moisture content. Values of resistivity have been calculated.

From this table it is obvious that if a certain resistance, say 10 ohms, was permitted in an earth connection, a grounding system which would be entirely adequate in clay ground would be found almost worthless in sandy soil.

[ED NOTE—This is the second of a series of articles on various aspects of grounding.]

* Consultant for James G. Biddle Company.

Resistivity of Different Soils

Soils	Resistance, (⅝ in. × 5 ft. Rods) Ave.	Min.	Max.	Resistivity, Ohms per cm.³ Ave.	Min.	Max.
Fills: Ashes, cinders, brine waste	14	3.5	41	2,370	590	7,000
Clay, shale, gumbo, loam	24	2	98	4,060	340	16,300
Same — with varying proportions of sand and gravel	93	6	800	15,800	1,020	135,000
Gravel, sand, stones, with little clay or loam	554	35	2,700	94,000	59,000	458,000

FOR OVERNIGHT Load Growth

Use Unit Substations

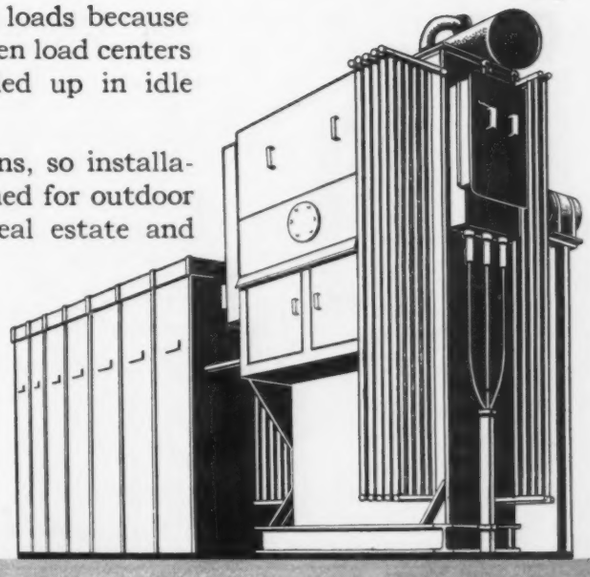
at the Load Center

YOU SAVE INSTALLATION TIME SPACE CONSTRUCTION

UNIT substations—your best bet for fast-growing loads because they're so easy to install, and as easy to move when load centers change. You'll never have large blocks of capital tied up in idle equipment.

A G-E unit substation is delivered in only two sections, so installation requires *days*, not weeks. It's compact and designed for outdoor service, therefore requires no large investments in real estate and buildings. And you can locate it *close to the load*, so feeders are shorter, losses lower, service better.

G-E unit substations not only meet today's unusual demands, but they provide *flexibility* for the changes to come. Ask your local G-E representative for additional information—or write for Catalog GEA-2996. General Electric Company, Schenectady, New York.



GENERAL ELECTRIC

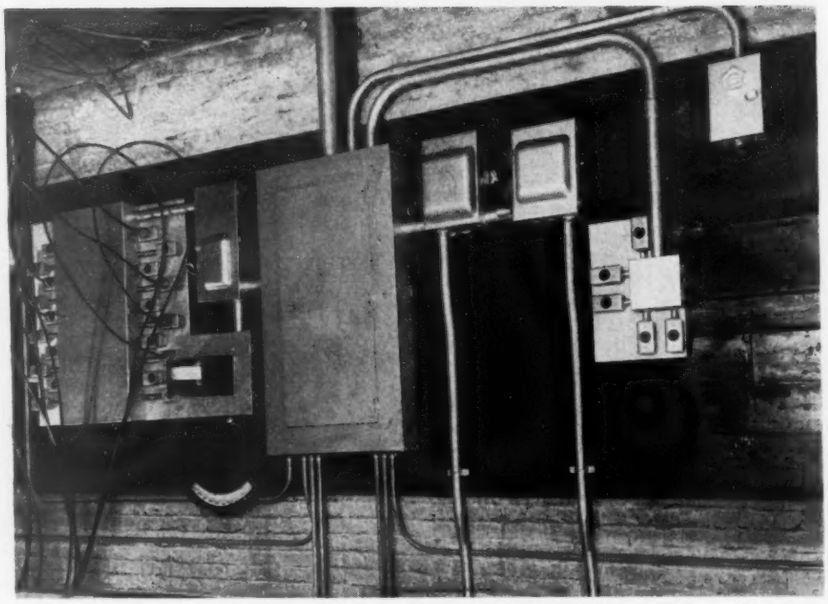
401-4-5155

INDUSTRIAL ENGINEERING

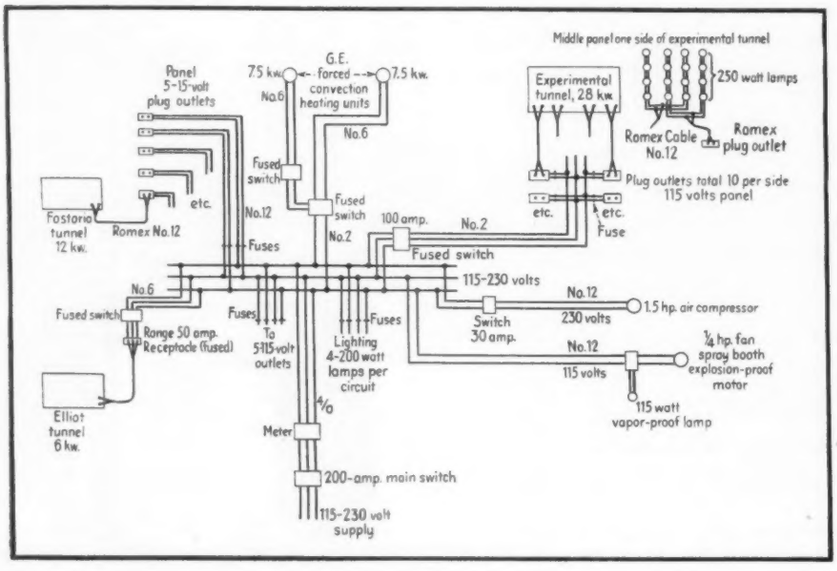
Wiring Layout for Radiant Heat "Lab"

To insure flexible service in the experimental work now being conducted for utility customers at the co-operative radiant heat laboratory recently opened at 483 Atlantic Avenue, Boston, under the auspices of five leading power companies and several manufacturers furnishing equipment, the wiring system was planned to secure comprehensive subdivision of circuits and maximum convenience of control. The main energy supply is received from a 115 - 230 - volt, three - wire service metered in the basement and distributed in the 70 x 24 x 12-ft. laboratory from a metal-clad bus cabinet in the center of a control board on which are mounted groups of switches and outlets associated with the numerous circuits.

Close attention has been given to balancing the various circuits on these buses.



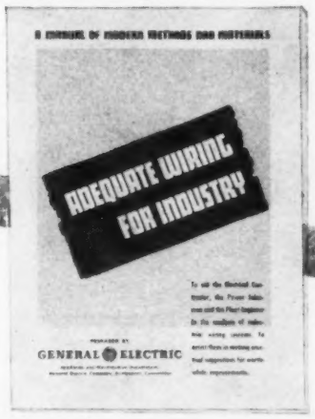
PLUG-IN CABLES serve portable infra-red tunnels



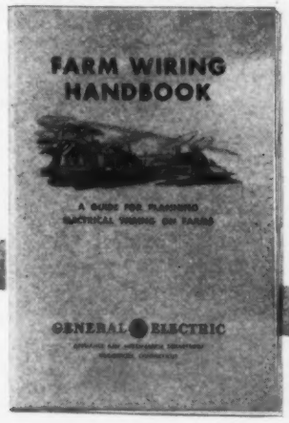
PLUG-IN CABLES serve portable infra-red tunnels

The major equipment of the laboratory includes a three-stage infra-red tunnel designed by the utility engineers and rated at 28 kw.; a 12-kw. Fostoria tunnel, and a 6-kw. Elliott oven. A 50-ft. conveyor has been constructed to carry samples through the tunnels, and a spray booth loaned by the Spray Engineering Company and equipped with a ¼-hp. explosion-proof motor-driven fan and other facilities for test work is provided in the establishment. Romex flexible cables are used to connect the portable heating equipment with the energy supply circuits in combinations as desired, flexibility being obtained through the use of 25 plug outlets to which the 115-volt circuits are brought from the main cabinet as illustrated. Switching and fusing are laid out for adequate overload protection and economical use of energy.

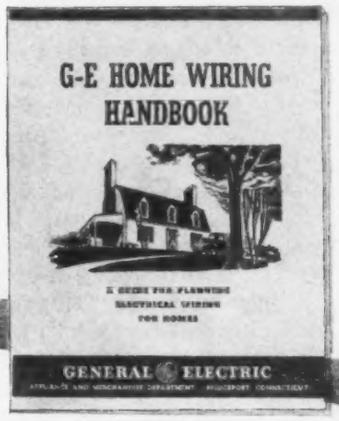
This handbook on industrial wiring outlines modern wiring practices which can be adapted for all factories. It will interest engineers, maintenance men, contractors and power salesmen.



This handbook is a guide in planning adequate wiring for the average farm and can be used with adaptations for specialized farms. It will interest electrical contractors and farmers.



This handbook describes modern methods for installing wiring that is adequate to serve appliances and high-wattage lighting in homes. It will interest architects and electrical contractors.



GENERAL ELECTRIC WILL HELP YOU TO PROMOTE ADEQUATE WIRING

This is a dramatic picture book for adults showing the need for adequate wiring in homes. It will interest new home builders and owners of existing houses.

This envelope suffer on adequate wiring can be enclosed with bills and letters handily. It will interest home owners and builders.

ADEQUATE WIRING SERVES AND SAVES

To co-operate in the movement for adequate wiring General Electric offers these five publications plus a complete line of wiring materials plus local distribution at all key points in the country,

ADEQUATE WIRING PUBLICATIONS

The publications are available for your use either in your own adequate wiring campaigns or in community campaigns in which you are taking part, or for occasional mailings. You may have 250 copies of each of these publications free for distribution in your territory. Additional copies may be obtained for a slight fee which will be quoted on request.

MATERIALS FOR ADEQUATE WIRING

General Electric wiring materials are ideal for adequate wiring systems. G-E conduit, wire and cable and wiring devices are all uniformly high in quality and are made to be used together. Only the finest raw materials are used. Manufacturing is done according to rigid specifications. And the line is complete which means that the right materials for any wiring job are available.

For copies of these adequate wiring publications and for more information about G-E wiring materials see the nearest G-E Merchandise Distributor or mail the coupon.

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The three-stage tunnel has a high bank of 25 250-watt infra-red lamps on each side, a medium bank of sixteen such lamps per side and a final bank of fifteen such lamps per side. It is mounted on wheels and the passageway between the two sides can be adjusted to fit the requirements of the work in process. The Fostoria tunnel is a standard frame with 48 250-watt infra-red lamps mounted on adjustable arms. The laboratory is heated by two 7.5-kw. General Electric forced convection heating units and is lighted by eight 200-watt lamps. Conduit sizes range from ½ to 2½-in. and a 1½-hp. air compressor is included in the equipment. The laboratory is operated under the supervision of J. L. Faden of Boston Edison and H. A. Hands of the New England Power Association.

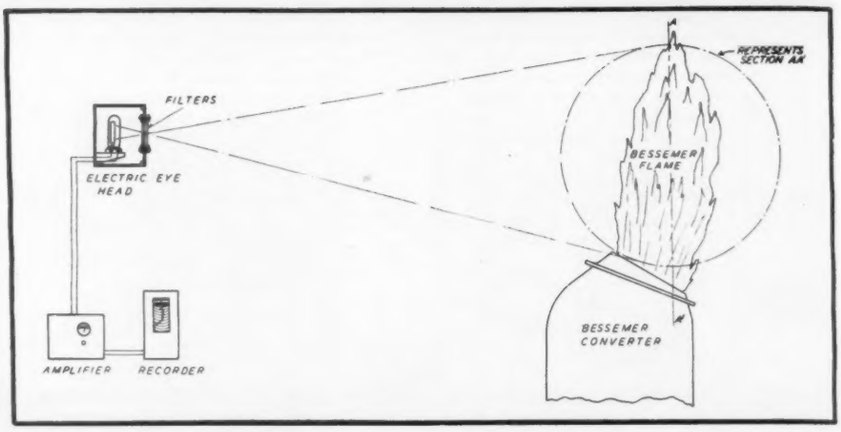
•

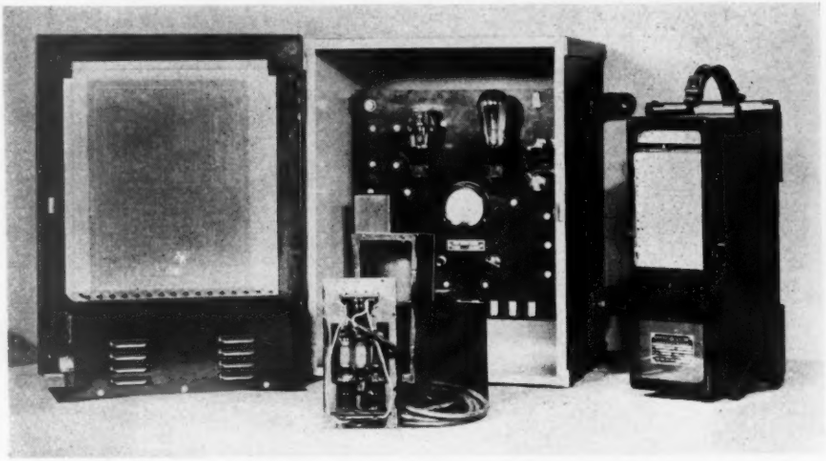
Photocell Control Aids Steelmaking

By DR. HAROLD K. WORK*
Manager of Research and Development
Jones & Laughlin Steel Corporation,
Pittsburgh, Pa.

Controlling the bessemer steelmaking process with photocell equipment provides a rapid and quantitative indication of changes in the flame, which are recorded graphically for each blow.

The selection of photocells to controll the "blow" was based on the fact that they were able to give an instantaneous and quantitative record of the flame behavior, and it was felt that, if suitable reference points could be found on which to base the control, this method would be far superior to one relying on the human eye.





PHOTOCELL CONTROL equipment gives more precise control of bessemer steelmaking process

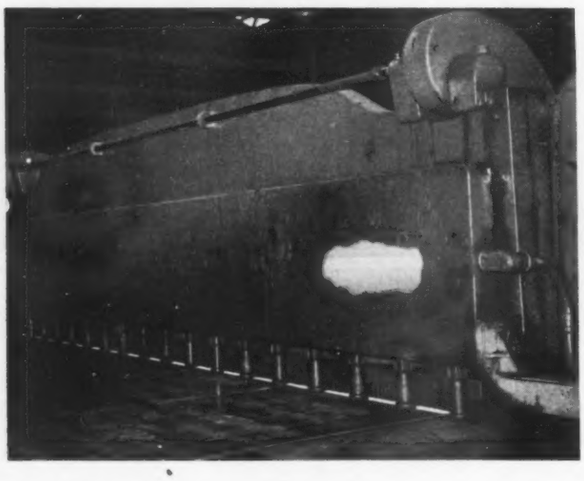
Schematic diagram shows position of control equipment with respect to converter flame. In equipment view, viewing head with three photocells is in foreground, amplifier back of it and graphic recorder to the right.

Three of the cells—General Electric "PJ-22" tubes are used—are mounted side by side in a housing and set up so the field of view includes the whole flame. Under these conditions variations in the position of the flame will cause a minimum variation in the reading. The unit is set up about 60 ft. from the converter, the exact location, of course, being determined by mechanical conditions in the mill. The response of the cells is amplified and recorded. Having this record has made possible a scientific study to determine the best blowing conditions.

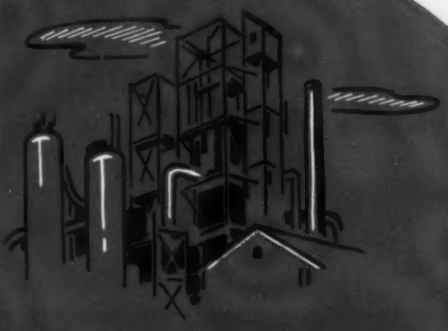
In order to use the photocell control most effectively it is desirable to employ filters on the viewing element. Infra-red filters, which showed certain operating disadvantages, were finally replaced with "standard photocell filter combination"—a combination of two filters, one of which can best be designated as a heat-absorbing filter and the other as an ultra-violet absorbing filter.

* Adapted from paper presented before New York meeting of American Institute of Mining and Metallurgical Engineers.

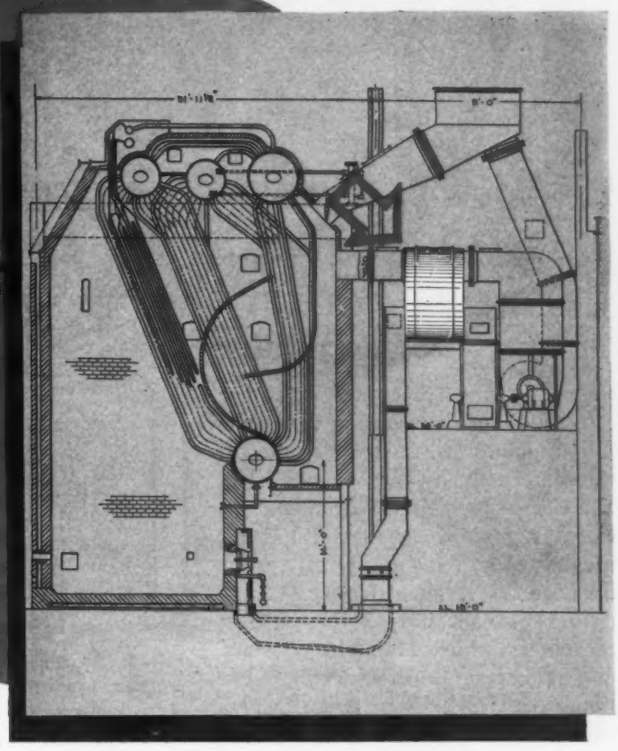
Line of Light Guides Shear



A narrow band of light from sixteen 18-in. green fluorescent tubes mounted end to end inside the shearing machine shown in this retouched illustration speeds the accurate cutting of large sheet steel plates at the Chicago Bridge & Iron plant, Chicago. The operator lines up markings on the metal with the straight-edge of light in preparing to make the cut. To show how the lamps are arranged a portion of the machine housing has been retouched to give a "cutaway" appearance.



A Fuel-Saving Answer To A "Burning" Question



FUEL IS SAVED for oil refineries by the flexibility and high efficiency of these modern steam generators, equipped with Ljungstrom Air Preheaters. » » » At a large oil refinery helping to meet one of the nation's most essential needs, modern steam generators like this are now in service. Each has a capacity rating of 104,000 lb. steam per hr. They are equipped with combination gas and oil burners, and their high efficiency in burning either type of fuel is enhanced by Ljungstrom Air Preheaters. At capacity rating, flue gases enter the preheater at 560° F., leave at 341° F., heating combustion air to 409°.

• • • • •

Because fuel costs may represent 20-30 per cent of the operating costs of an oil refinery, efficient combustion is *always* important. Right now, however, fuel saving has a greater significance, measured in terms of the national welfare.

In recent years, many foresighted oil refineries have re-examined the economics of power-plant operation giving greater weight to fuel conservation. In this program, the use of combustion air preheated in *Ljungstrom continuous regenerative counterflow units* has contributed materially to fuel economy.

These compact heat-transfer units save space and save steel. Their mechanical dependability has been established in service on some of the nation's outstanding power plant installations. They protect the continuous availability of the boiler for service, as maintenance can be quickly accomplished in scheduled outage periods, or even postponed in an emergency.

Facts and figures are available on the performance of Ljungstrom Preheaters for large or small boiler plants, for industrial or utility service, using any type of fuel. Write for them today.

THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd St., New York, N. Y. **Plant: Wellsville, New York**

NEW ENGINEERING IDEAS

Use Resonant Circuit in New C.C. Regulator

A constant-current transformer for street-lighting service known as type Y-H regulator which has been introduced recently by the Wagner Electric Corporation differs from conventional regulators in that it has no moving coils, but consists of a combination of resonance circuits consisting of capacitors and iron-core reactances which maintain constant output current over a very wide range load resistance. A series and parallel combination of inductive and capacitive reactances (Fig. 1a) is so arranged that with changes in the load circuit resistance the impedance of the regulator automatically adjusts itself to maintain constant current output.

A conception of the operation of this unit may be obtained from Fig. 1b, which shows the resonance circuit only: Inductive reactance 1 and the capacitive reactance 2 (respectively 3 and 4) are in series resonance, consequently the voltage between AD as well as between AC and BC and BD is many times larger than the supply voltage when no connection exists between the points A and B or if a very high impedance is connected across the points A and B. Consequently also very high voltage appears across the points A and B under the conditions cited. If the points A and B are short circuited the system can be considered as consisting of two parallel resonance circuits connected in series. One of the parallel resonance circuits consists of circuit C1AB4. The other parallel resonance circuit consists of D2AB3. Each one of these parallel circuits receives one-half supply voltage. In any parallel resonance circuit a fixed current flows from the reactance into the capacitor. Consequently a certain current flows from the capacitor No. 2 into the reactance No. 3 over the short at AB. Also a current of the same magnitude flows from the reactor No. 1 into the capacitor 4 through the short AB. The sum of these currents constitutes the total current flowing in the short AB. For a given voltage impressed across C-D this current has a very definite magnitude, depending only on the reactance values of said circuits. From the above reasoning it follows that definite current flows across AB when these points are shorted and that if the points AB are open circuited, a high voltage occurs across

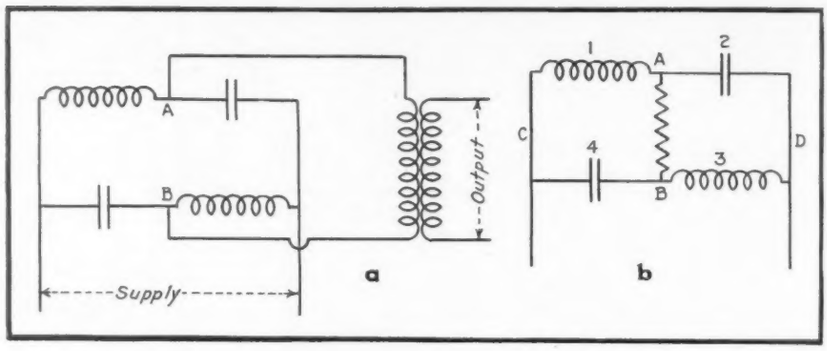


FIG. 1—A combination of resonance circuits consisting of capacitors and iron-core reactances is arranged (a) so that with changes of load circuit resistance the impedance of the regulator adjusts itself to hold constant current output. For explanation purposes resonance circuit is shown (b)

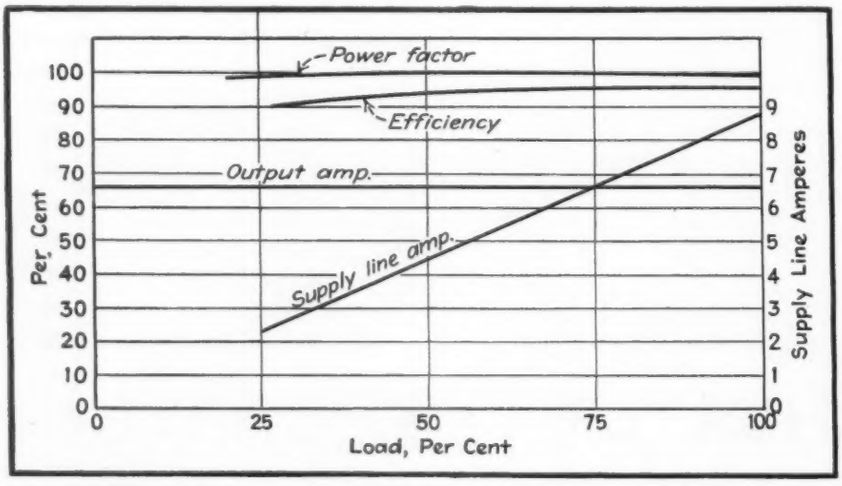


FIG. 2—Characteristics of a 20-kw. new type constant-current regulator for 2,400-volt supply

POWER CABLES MUST NOT BE "Slackers"

Feeder cables carrying power to our all important defense industries must not be slackers. They must carry their full load steadily under ordinary conditions and more when emergencies arise.

Simplex - ANHYDREX AA - LL rubber insulation was designed for just such service conditions. In it are combined the remarkable resistance to water absorption of ANHYDREX AA - 60 deproteinized rubber insulation, with the aging characteristics of the best long life insulations. With it conductors can be operated at temperatures which would be unreasonable with ordinary insulation. With it you can safely carry more power and carry it longer.

Benefits like these are made available for industry as a result of chemical research. Simplex laboratories are known throughout the wire and cable industry for the many important improvements in insulations for wires and cables.

May we send you a copy of our Data Sheet No. 112 on Simplex-ANHYDREX AA-LL deproteinized rubber insulation? It contains information that should be of interest to every user of wires and cables. A post card or letter will bring it to you promptly.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Simplex-ANHYDREX

deproteinized rubber insulation for wires and cables

these points. This means that the output current will have a constant value over a very large range of load resistances.

The design is said to have the advantage of having high efficiency and excellent power factor from full load to a small fraction of full load. Consequently the supply line current drawn by this device is considerably less than that of a constant current moving coil regulator whose power factor and efficiencies decrease rapidly with decreasing load. The iron circuits of this regulator are so dimensioned that a constant current output is obtained from short circuit condition up to full load and reasonable overloads.

Typical characteristics of a 20-kw. regulator are shown in the illustrations on page 98.

The switch used for controlling and protecting the regulator is operated by a remote-control circuit through either a time switch or manually operated switch. Due to an ingenious arrangement of the circuits the control switch contacts never open or close under load, resulting in practically sparkless operation, long life and minimum maintenance. As soon as the output voltage reaches a predetermined value, which lies somewhat above the full load voltage, the protecting switch opens automatically and disconnects the regulator from the supply line as well as from the load circuit. Furthermore, the regulator is so designed that its open circuit voltage is limited to a value slightly in excess of the voltage which opens the protector switch and disconnects regulator from the supply.

Output terminals of the regulator can be short circuited continuously without excessive heating. When a short exists the secondary current remains equal to the normal full load current, while the primary current falls to practically zero. A short across the load loop can be opened while creating practically no arc.

• • •

Lenses Control Light From Fluorescents

Recently developed Holophane "Controlenses" not only shield fluorescent lamps from vision and thus make for low surface brightness but also afford control of the direction of the light from the lamps. Designed for general lighting applications, industrial as well as commercial, the lenses are of the cylindrical plano-convex type, regressed to a flat plane by prismatic "steps" or segments, somewhat in the manner of a Fresnel lens.

Three general types of lenses provide for three types of distribution characteristics: Intensive, for uniform spacing; concentrating, for accent lighting or high ceilings; extensive, for vertical surfaces or low ceilings. With the intensive type, spacings up to 1¼ times the mounting height above the working plane are permitted for uniform illumination. With the concentrating or focusing, suggested especially for precision lighting requirements, different spreads are obtainable which permit different mounting and spacing ratios from 1/10 to 7/10 of the mounting height. With the extensive type, recommended particularly for industrial operations calling for vertical illumination, spacings up to two times the mounting height above the working plane may be used.

While the accompanying distribution curves apply to two 40-watt "F" lamps (except for the concentrating type), the lenses might be used with one 40-watt lamp or one 100-watt lamp.

Illumination values obtainable from fixtures using these lenses may be estimated for average ceiling and wall finishes. (Because of the variations possible, similar data cannot easily be given for the concentrating type lens.)

First, find the "room index" for the interior involved:

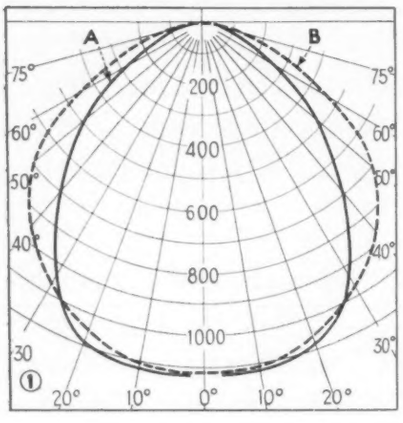
$$\text{Room index} = \frac{(2 \times \text{width of room}) + \text{length}}{6 \times \text{mounting height above work}}$$

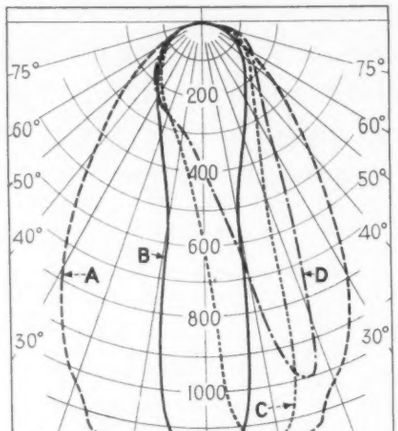
After the room index has been calculated, it may be used to find the coefficient of utilization from this table:

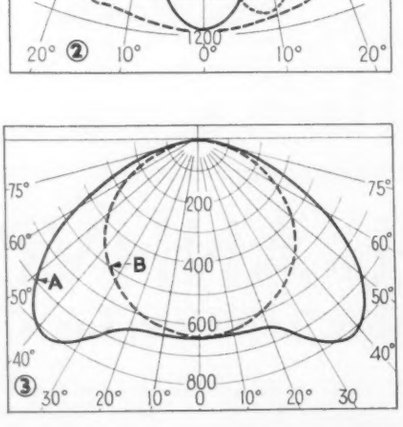
Room index	Coefficient of Utilization (Two 40-Watt Lamps) Intensive Type Lens	Extensive Type Lens
1	0.45	0.39
1.5	0.50	0.44
2	0.54	0.46
3	0.59	0.51
5	0.61	0.53

Substitute the coefficient of utilization in this formula:

$$\text{Illumination in foot-candles} = \frac{\text{Total lumens of all lamps} \times \text{Coefficient of utilization}}{\text{Area of room in square feet}}$$





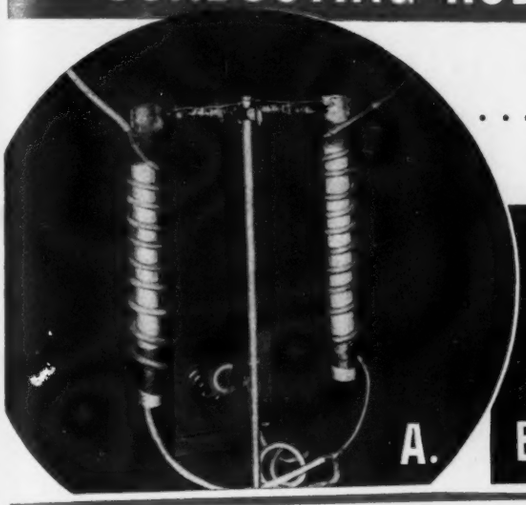


PRISMATIC GLASS LENSES permit reduction of rays from fluorescent lamps for different light distribution characteristics

Intensive lens (1) used with 40-watt lamps, 4,200 lumens total, placed 2½ in. above lens, 1½ in. either side of center line of fixture. Distribution curves: (A) across axis of lamp; (B) along axis. Concentrating lens (2) with one 40-watt lamp, 2,100 lumens, 5-in. focus. Distribution curves: (A) along axis of lamp; all other curves across axis (B) no offset; (C) 1-in. offset; (D) 2-in. offset. Extensive lens (3) with two 40-watt lamps, 4,200 lumens total, placed 2½ in. above lens and spaced ⅞ in. either side of center line of fixture. Distribution curves: (A) across axis; (B) along axis.

CONDUCTING RUBBER makes it possible...

Makes any cable insulation "Corona proof" . . . dissipates static electricity and adds to the life and safety of POWER CABLES



Look at this test...

A VOLTAGE OFF

Both cables are wrapped around mandrels. The conductor on the left is insulated with "ozone proof" rubber, but not shielded. The conductor on the right has the same type of insulation with a surface covering of CONDUCTING RUBBER—same total thickness of wall in each case.

B VOLTAGE ON

Visible corona appears at the surface of the unshielded conductor on the left. On the second conductor, American Steel & Wire Company's Type PS Semi-Conducting Shielding prevents corona formation.

Amerclad rubber-sheathed shovel cable with Type PS Semi-Conducting Shielding. Note ground wires between shielded conductors.

TYPE PS Semi-Conducting Shielding (conducting rubber), a new development by American Steel & Wire Company, solves an old and troublesome problem in the manufacture of insulated cables. By research and by experience, we have proved that Type PS Shielding completely eliminates the deteriorating effects of corona by preventing corona formation. Besides controlling "electronic ionization of air," it also:

1. Increases the life of power cables and widens the range of applications.

2. Protects against shock hazard by providing a grounded exterior.

3. Prevents electrical disturbances from being radiated from the cable or absorbed by it.

Type PS Semi-Conducting Shielding is always in intimate contact with the cable insulation proper. When used with rubber insulation, it adheres to the rubber and becomes an integral part of its surface. By preventing corona and consequent generation of ozone, Type PS Shielding permits the use of standard rubber insulating compounds for high voltage service. No longer is it necessary to employ oil-base compounds in which some degree of corona-resistance is obtained only by sacrificing such typically rubber-like qualities as tensile strength, elasticity, ability to withstand heat and to resist deformation.

Write today for our technical bulletin and other information.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

LOAD BUILDING

Cooling Storage for Offpeak Operation

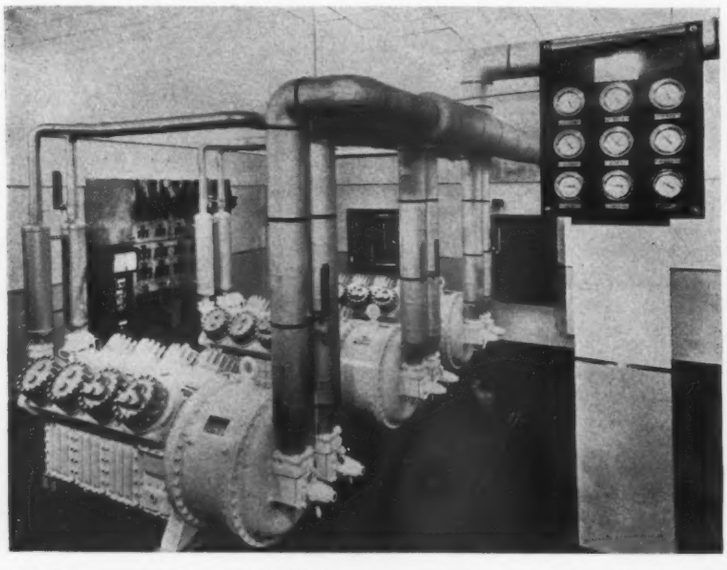
The new air-conditioning system of the Saenger Theatre in New Orleans, La., reduced demand from 659 hp. to 275 hp., takes up only one-half the space previously needed, the number of rotating machines has been reduced almost 50 percent, and with fewer machines, plus the use of three 75-hp. Westinghouse hermetically sealed compressor units, is expected to reduce maintenance materially. A unique water storage system aids in using off-peak power.

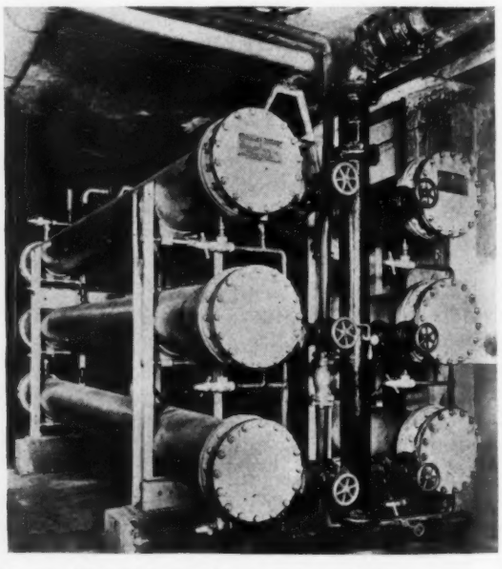
New Orleans cooling season begins in March, lasts well into November and at times cooling is required during parts of the winter months. Though the old equipment at the theatre had done a good job, its high energy consumption was becoming costly. Breakdowns were increasing in frequency and inefficiency of CO_2 as a refrigerant was recognized.

It was finally decided to replace the old system with three hermetically sealed 75-hp. compressors, using Freon as their refrigerant. Horsepower required by the three new compressors is only 225, as compared to 524 hp. needed before. The new system cools by direct expansion through new coils placed in the existing conditioning chambers. Cooling is under full automatic control.

Because operation of the cooling system between 5 p.m. and 7 p.m. on the peak load period of New Orleans Public Service naturally costs more than at other times, the old water system with its big storage tank is utilized to store up cooling capacity to take care of this daily two-hour period. The excess compressor capacity available during normal working hours is used to cool the water in the tank with existing Baudelot coils.

During normal cooling operation the old system required 491 kw., and if cooling was required during the daily peak period this 491-kw. load had to be put on the line at the time of system peak. Now, on direct expansion, the new system, by eliminating all water pumps, requires only about 205 kw., or 58 percent less power. When the water system is being cooled for storage, with necessary running of the circulating pumps, the required power increases to about





THREE hermetically sealed 75-hp. compressors (left) using Freon, installed at New Orleans theatre to replace 524-hp. system installed thirteen years ago and to permit off-peak operation

Unique use of the existing chilled water tank and spray booths for storage of cooling capacity results in an added saving by relieving the compressors from running during the daily New Orleans peak power period. During these two hours the stored water, chilled by extra capacity operation of the compressors during normal operation periods, is used to cool the conditioned air. Shell and tube condensers (at right) used with the old CO_2 system are now used to condense the Freon after its expansion into the new coils installed in the existing water spray booths. The heavy black pipe carries the cooling water.

New low prices mean more sales of
G-E MAZDA FLUORESCENT LAMPS

EFFECTIVE August 1st, General Electric announces lower prices on its entire line of G-E MAZDA F (fluorescent) lamps. The increasing demand for this new cooler, high efficiency light source has resulted in even greater manufacturing economies. In line with long established policy, General Electric passes these savings along to your customers. This is another step in the reduction of the cost of better light for better sight.

Since G-E MAZDA F lamps were first introduced in 1938, light output has been increased as much as 40% and as of August 1st, prices have been reduced as much as 52%. When you buy fluorescent lamps, make sure you are taking full advantage of G-E research that is producing *lamps that give maximum* light for the current consumed. Look for the G-E monogram on every tube.

NEW LOW PRICES ON G-E MAZDA F LAMPS

August 1, 1941

14-watt T-12	was $1.05	NOW 90c
15-watt T-8	was 85c	NOW 75c
15-watt T-12	was $1.10	NOW 95c
20-watt T-12	was $1.10	NOW 95c
30-watt T-8	was $1.10	NOW 95c
40-watt T-12	was $1.60	NOW $1.35
100-watt T-17	was $3.50	NOW $3.00

Above prices refer to daylight and 3500° white.
Prices also reduced on soft white and colored G-E MAZDA F lamps.

In addition to above reductions, prices are also reduced on the following types of G-E MAZDA (filament) lamps.

50-100-150 watt (Three-Lite lamp)	was 45c	NOW 40c
100-200-300 watt (Three-Lite lamp)	was 60c	NOW 55c
300-watt R-40 Reflector lamp (Spot or Flood types)	was $1.70	NOW $1.40

G-E MAZDA LAMPS
GENERAL ELECTRIC

Made to stay brighter longer

240 kw., still a decrease of 51 percent from that required by the old system. These percentages do not take into account the further saving made possible by not having to run the compressors during the two-hour daily peak power period.

•

Range, Water Heater Sales in Volume

By J. B. BUMAN
Manager Residential and Rural Sales
Northwestern Electric Company, Portland, Ore.

In our load development plans we include electric range and water heater activity in our all-service sales program, and in our newspaper advertising we run the advantages of electric cookery and the comforts of electric hot water service in separate advertisements.

We have reached a point of saturation (42 percent) in electric ranges that has removed largely the seasonal buying element. Fifteen years ago we sold heavily in the spring and summer, placing great emphasis on the modern cool electric kitchen. Thus we ourselves restricted the value of electric cookery at that time and narrowed the field of acceptance.

Cleanliness Big Salespoint

Since then we have learned how to sell electric cookery, because we have discovered why women want it. The big reason is the marvelous cleanliness that is found in no other apparatus to do the same job and the stimulation of a more charming atmosphere throughout the house. Thus the march of electric cookery is now twelve months in the year, showing only slight curves upward in the spring and in the fall, which are the moving seasons in most parts of the country. In spite of our saturation, last year more of our customers installed electric cookery than ever before in the same period. Of 2,726 ranges installed, less than 25 percent were replacements. And probably 85 percent of the used ranges went back into use in other homes.

In electric hot water heating, last year our sales were nearly doubled. Every index indicates to us that electric hot water service will be the next big forward movement by the progressive home owners. The dealers in our territory have only been in the business seriously for the past two years. Typical of a new business finding its bearings, it has gone through all the vicissitudes of price cutting, high trade-in values, below-cost installations and, in fact, improper selling of every kind.

This stage of electric water heating business is now passed. Every appliance dealer is becoming alert to the business; he now recognizes that here is an appliance that must be sold properly, that has a large volume and that has the same legitimacy as the radio, the washer or any other large appliance.

Standardization Needed

There seems to be only one bugaboo left in the water-heating business that acts as a stop-gap for a more thorough national push. It is time that utility engineers, manufacturers and sales executives reduce the equation to a few standard water-heating specifications that will stimulate a general enthusiasm for the business everywhere. Today there are more than 600 specifications in use for electric water heaters throughout the country. This makes for a series of complications for the manufacturer, the jobber, the appliance dealer and the salesman. Of course, all these specifications are not in use in any one locality, but there is ultimate need of some standard that may be used generally.

1,100 Fluorescents for Defense Tool Builder

Plenty of room for all and the latest in lighting, air-conditioning and office equipment feature the new drafting and engineering rooms of the Warner & Swasey Company, Cleveland turret lathe builders.

Occupying the entire fifth floor of the main building (16,000 sq.ft.), the new layout gives the company's four engineering departments—standard machine design, standard tool design, special tool design and development design—almost three times as much space as they previously occupied and brings all these departments together in one building on one floor.

The lighting consists of 1,140 fluorescent tubes covered with diffused louvered glass that is flush with the acoustically treated ceiling. These lights provide 40 ft.-candles on the drawing boards.

Provision has been made for both winter and summer air conditioning. A 50-ton compressor is used for summer cooling. Electromatic filters clean the air of dust and air movement is at the rate of 16,000 cu.ft. per minute.

Departments are separated by steel and glass partitions which are 8 ft. high. Rooms are finished in soft colors—ceilings white, walls light green and partitions dark green.

WARNER & SWASEY, important builders of turret lathes for defense effort, equip new engineering and drafting department with year-round air conditioning and with 1,140 fluorescent tubes to provide 40 ft.-candles

YOU GET THE IMPRESSION

of quality at the first sight of

SHAWMUT

SHUR-LAG

RENEWABLE FUSES

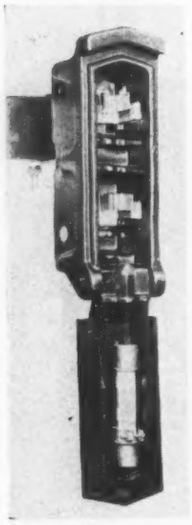
Because all Shawmut products are made for performance, not for cost. A Shawmut fuse is the fuse to use, if you want the right fuse in the right place, to do the right thing always. Shawmut Shur-Lag Renewable Fuses are the sturdiest, simplest, and most efficient of all time-lag fuses, and the speediest and easiest to renew. They give full protection at all times and under all conditions; they save you lost time and production due to inefficient fusing; they ensure you complete security and satisfaction. A dozen or more outstanding features place them far ahead of all other time-lag fuses in economy, safety, and convenience. Ask your dealer or write for our Bulletin 400.

THE CHASE-SHAWMUT COMPANY
NEWBURYPORT, MASSACHUSETTS

FUSE MAKERS SINCE 1893

NEW EQUIPMENT

Fuse Cutouts



Distribution fuse cutout; available for use with type EJ-1, size A current-limiting fuse unit 1-IN at 2,500 volts, 60 cycles, with interrupting rating of 25,000 amp.; size B fuse units 1-IN to 3-3N amp. at 2,500 volts, 60 cycles (illustrated) and 0.5-0.5N amp. at 5,000 volts, with 40,000 amp. interrupting capacity, and size C fuse units from 1-IN to 40-25N amp. at 2,500 volts, 60 cycles, with 80,000 amp. interrupting capacity. **General Electric Co.**, Schenectady, N. Y.

Cutouts which combine current-limiting fuses with porcelain - inclosed housings of the kind used for distribution fuse cutouts of the non-indicating type extend application of the inclosed housing idea to current-limiting fuses for potential and auxiliary transformers. Mounting can be on a pole, pipe, crossarm, channel or other similar framework. Mounting of current-limiting fuse on the hinged doors provides a convenient form of disconnect switch. Inclosure of fuse is said to eliminate danger of accidental contact.

•

Relay

Type "F" relay; available with 1, 2 or 3 poles; single- or double-throw; to operate on a.c. or d.c.; 2¼ in. high, 2½ in. long, 1⅛ in. wide. **G-M Laboratories, Inc.**, Chicago, Ill.

One of several new models to be announced by this company, this relay features self-cleaning, wiping-action contacts, with heavy contact pressure.

•

Regulator-Exciter

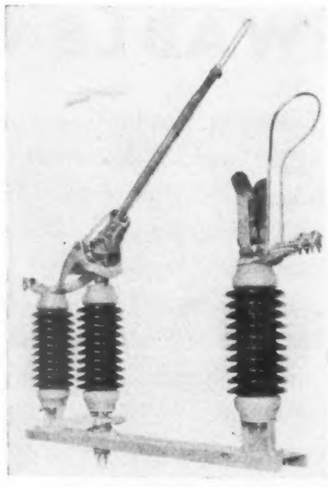
"Regulex" exciter; being developed for all sizes of d.c. machines and applicable to a.c. synchronous motors, generators and condensers. **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis.

Exciter and regulator are combined in this unit, which consists of a differential amplifier for controlling excitation on d.c. motors and generators to give constant voltage, current, speed or tension. Originally developed principally for steel mill use to provide constant tension on winding and unwinding coils, it is being applied to other steel mill drives and mine hoists.

•

Switch

Two outside insulators in this switch are stationary, while the third is mounted on ball bearings and can be rotated by hand or by motor. Blade mechanism is mounted on 45-deg. inclosed bearing that imparts a rotating insulator motion to switch blade, simultaneously lifting and turning it. Opposite rotation of insulator unit lowers and turns blade into high-pressure contact with spring-locked contact shoes mounted on right-hand outside insulator unit. By means of "high spot" cam on 45-deg. rotating bearing, high-pressure contact is also made at hinged end of blade.

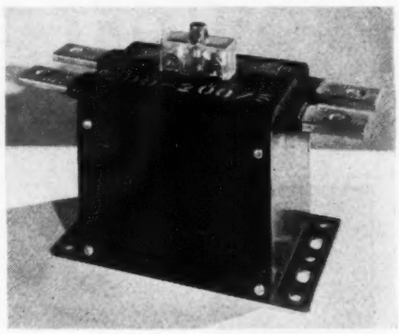


Dual-high-pressure-contact switch; for all voltages and capacities to 4,000 amp.; single-pole unit (pictured) is for 34.5-kv., 600-amp., three-pole service. **Delta-Star Electric Co.**, Chicago, Ill.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Current Transformer

Designed for three-wire metering applications, dry type indoor current transformer has practically flat ratio and phase-angle curves from 15 to 200 percent current,



Type "TW" indoor current transformer; eighteen ratings, ranging from 5 to 500 amp., 1,200 volts. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

resulting in high metering accuracy over a wide range of loads, it is claimed. Any unit may be interchanged with another of a different rating. Secondary short-circuiting switch is mounted on top of the transformer inside a transparent plastic cover.

•

Fluorescent Unit

"Miralume" "F-104, F-208, F-154, F-308" continuous row fluorescent lighting units, using two or three 40-watt T-12 lamps. **Hygrade Sylvania Corp.**, Ipswich, Mass.

Designed for use with 5-ft., 100-watt fluorescent lamp, this fluorescent ceiling light is available with a nine-fin louver as an accessory. Individual sections couple together to make up continuous runs; feeder lines can be carried from one unit to another through the wiring channel. Unit is made of steel with baked aluminum finish.

•

Motor Cushioning

Rubber "Isolators." **The Korfund Co., Inc.**, Long Island City, N. Y.

As additions to its line of anti-vibration mountings, this company has announced new types employing rubber as a cushioning medium, particularly for small motors and light-weight machinery. Rubber-in-shear types are offered with individual load capacities from 25 to 450 lb. and may be combined for greater capacities. Rubber-

MANUFACTURING - MARKETS

Westinghouse Profit Gains in Six Months

Net profit of Westinghouse Electric & Manufacturing Co. for the first six months this year totaled $11,568,401, equivalent to $4.33 a share on combined shares of 7 percent preferred and common stocks. This compares with $9,837,012, or $3.68 a share, on combined stocks in the same 1940 period. The profit for the first six months this year allows for $8,395,264 in normal federal taxes and $9,239,528 excess-profit taxes, against normal taxes of $2,942,110 in the 1940 period.

President George H. Bucher said that sales billed in the first six months totaled $175,557,093, against $115,488,876 in the 1940 period.

Bookings rose 131 percent to $566,047,983 for the year ended June 30, from $245,256,874 in the 1940 period. Billings were $299,499,664, against $202,843,336. Unfilled orders as of June 30 were $341,265,794, as against $86,386,749 a year ago.

Mr. Bucher said that employment is at an all-time high of more than 71,000, an increase of 35 percent since last summer.

•

Hygrade Plant Causes Danvers System Growth

Completion of the new Danvers, Mass., fluorescent tube factory of the Hygrade Sylvania Corp. on an October 3 schedule will increase the demand on the municipal light department 150 percent, and to meet this, Leo Nimblett, manager, with the advice of Carroll A. Oliver of Belmont, consulting engineer for the department, is adding about $40,000 worth of equipment and material to the distribution system.

The department is extending a 22-kv. cable underground to the new plant and installing an Allis-Chalmers unit substation of 2,000 kva. for this service. By forced cooling the ultimate capacity of the transformers will be 2,600 kva. The plant is being built by the Austin Co. under a defense priority order. Simplex Wire & Cable Co., Cambridge, Mass., is supplying the cable for this work, the James Sugden Co., Boston, being the contractor.

It is anticipated that with the completion of the new factory additional residential loads will be taken on by the lighting department. All energy distributed by the Danvers system is purchased from the Eastern Massachusetts Electric Co., a New England Power Association subsidiary utility.

•

Production Gain Set by General Electric

General Electric Co. is passing through the greatest period of expansion it has ever attempted in answer to the Navy Department's call for greater production of turbines and other equipment for ships.

Production facilities at Lynn, Mass., Erie, Pa., and Schenectady, N. Y., have been greatly expanded and placed on 24-hour-a-day schedules to keep pace with Navy requirements.

About $20,000,000 will be spent in construction and equipping a new factory to be built at Fort Wayne, Ind., by the company to manufacture turbo-superchargers for airplanes. The company has completed its new "blackout" supercharger factory at Everett, Mass.

•

Phelps Dodge Expansion

Phelps Dodge Copper Products Corp. has authorized another addition to the Habirshaw, Yonkers, N. Y., plant to take care of national defense production. The work will be completed next September.

Allis-Chalmers Net $2,389,576 in 1941

Allis-Chalmers Manufacturing Co. reports, for the second quarter of 1941, a net income of $1,793,108, or $1.01 a share on 1,776,092 no-par shares of common stock outstanding at the close of June, after tentative provision of $1,420,000 for federal income and excess profits taxes. The net income for the second quarter of 1940 was $1,639,889, or 92 cents a share, after providing $733,000 for federal income taxes.

Billings amounted to $28,725,320 and orders booked $51,498,173 in the second quarter, which compares with billings of $25,125,448 and orders booked of $27,430,565 in the 1940 second quarter.

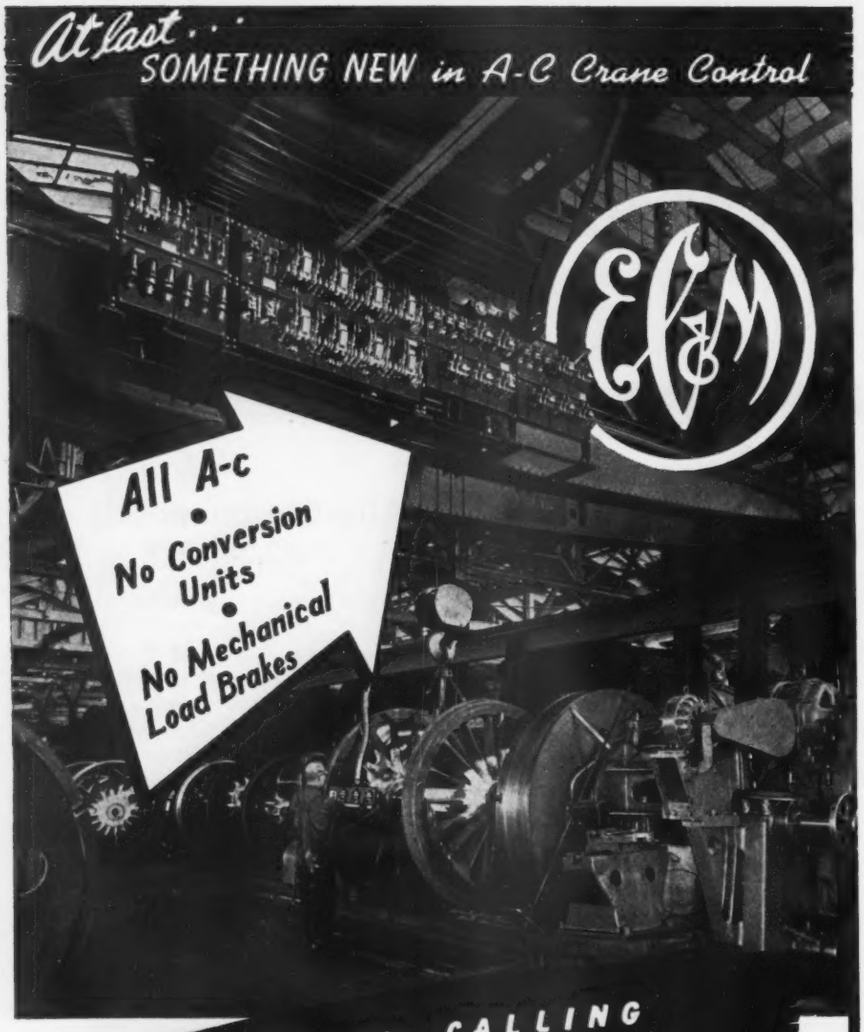
For the six months of 1941 the net income was $2,389,577, or $1.34½ a share, after provision for federal income and excess profits taxes, compared with $2,609,758, or $1.47 a share, in the similar period of 1940. Orders booked for the first half year amounted to $84,388,559, or 77 percent over the $47,584,526 bookings in the same period of 1940. Unfilled orders on hand June 30, 1941, totaled $95,145,147, compared with $59,755,289 at the close of 1940.

The first quarter earnings, according to the company's report, were affected seriously by the strike, which practically suspended all production at the West Allis works from January 22 to April 8—76 days.

Among the other manufacturing companies issuing reports are the following:

ROME CABLE—June quarter: Net profit, $120,734, equal to 64 cents a share on 189,830 capital shares, compared with $60,570, or 32 cents a share, for quarter to June 30, 1940. Figures are after $162,599 provision for estimated normal and excess profits taxes in 1941 quarter, compared with $11,832, in 1940 period.

SQUARE D—Six months to June 30, net profit, after $2,950,000 reserve for normal and excess profits taxes, $1,397,346, equal



ON A JOB CALLING FOR PRECISION HANDLING

YOU, too, can protect extremely valuable machine tool centers and enable your operator to guide the work carefully into position with an EC&M A-c Dynamic Lowering Frequency Relay Magnetic Hoist Controller.

Within practically the first year of announcement nearly 100 of these hoist controllers have been ordered for new and old cranes. Users report spotting as close as 1/32" easily done. If you have an A-c crane or are considering the installation of one, put it under control of EC&M Frequency Relays and LINE-ARC Magnetic Contactors. Ask for Booklet 930.

THE ELECTRIC CONTROLLER & MFG. COMPANY
2700 E. 79th Street Cleveland, Ohio

Please send A-c Magnetic Controller Booklet 930

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Address.....

MOTOR CONTROLS - BRAKES - LIMIT STOPS - MAGNETS

after preferred dividend requirements to $3.19 a common share, compared with $905,130, or $2.03 a share last year, when tax reserve was only $274,762. Current assets at June 30, 1941, including $1,301,678 cash, totaled $8,747,938 and current liabilities were $5,510,232, including $4,016,020 reserve for taxes on income.

McGRAW ELECTRIC—Twelve months to June 30, net profit, $1,678,726, after $1,223,050 provision for Federal and State income and Federal excess profits taxes, equal to $3.55 each on 472,600 shares of capital stock. Net profit for the twelve months to June 30, 1940 was $1,519,329 or $3.21 a share. Net sales totaled $9,786,133 and $7,293,651, respectively.

•

Westinghouse Dedicates New Fluorescent Plant

Gov. M. M. Neely of West Virginia and civic officials joined with Westinghouse Electric & Manufacturing Co. last Saturday in dedicating the new $3,000,000 fluorescent lamp works at Fairmont, W. Va.

The plant will eventually employ over 1,000 persons. It is the largest factory devoted solely to fluorescent lamp manufacture and will turn out 50,000 lamps a day. On a nearby site Westinghouse is now constructing a $1,800,000 glass factory.

•

Moves Receiving Offices

Roller-Smith Co., Bethlehem, Pa., has announced that its receiving department will be located at 106 East Walnut Street, Allentown, Pa., and that all purchase material should be addressed there. Invoices should be sent to the company's headquarters at Bethlehem, as in the past.

•

June Range Sales Spurt

Sales of electric ranges during the month of June in Continental United States, Alaska and Hawaii totaled 68,629 units, compared with 33,403 units in June, 1940, according to an announcement made by the National Electrical Manufacturers Association. For the first six months total sales billed amounted to 363,633 units, compared with 228,730 units for the similar period of 1940.

New York Metal Prices

	August 5, '41 Cents per Pound	July 30, '41 Cents per Pound
Copper electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.85	5.85
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc Spots	7.64	7.64
Tin, Straits	52.75	53.50
Aluminum, 99 per cent	17.00	17.00

* Delivery Connecticut Valley.

That TOUGH "ROME 60" WELDING CABLE

Meets all the requirements of the I.P.C.E.A.-N.E.M.A. Standards

IN ADDITION, it has the following Exclusive Feature —A Thermoplastic separator between the cotton wrap and the protective cotton braid under the tough 60% jacket. The Thermoplastic Tape not only acts as a separator which keeps the copper conductor bright and clean, but it softens under heat and molds the cotton coverings together in one solid unit, which resists twisting in either direction without impairing flexibility.

Indeed, an exclusive and an important feature.

ROME CABLE CORPORATION

ROME, NEW YORK

SALES OFFICES

NEW YORK CHICAGO CLEVELAND
PITTSBURGH DETROIT LOS ANGELES
RICHMOND PHILADELPHIA BOSTON

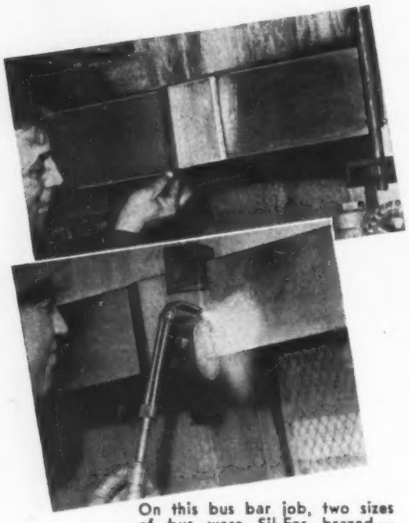
Hot Rolled Copper Rods * Bare and Tinned Strand * URC Weatherproof Wire
Bare and Tinned Copper Wire * Rubber Insulated Wires and Cords
Lead Covered Cables * Cotton, Paper and Asbestos Magnet Wire * Rome 60
Multiconductor Power Cables * Network, Service Entrance, Control Cables

More and more BUS-BARS are being BRAZED WITH . . .

SIL-FOS

THE use of Sil-Fos in brazing bus bars is spreading rapidly. Below are illustrations of an installation recently made in a large Brooklyn, N. Y., brewery.

Here is what you gain when Sil-Fos brazing is used. You save time and cost—there's no drilling or punching, no bolts or clamps to assemble. You save on bus bar metal — only small laps are required. When the job is completed you have joints as efficient electrically as the bus bar itself—joints that are trouble-free because they can't loosen up or oxidize. In fact, you have a bus system that literally has no joints and hence is free of joint maintenance.



On this bus bar job, two sizes of bus were Sil-Fos brazed — 9" x ¼" and 6" x ¼". The lap is approximately ¾". Brazing was easily done in close quarters.

GET THE FACTS NOW

Learn about Sil-Fos brazing now so that you can take full advantage of it on your next bus bar job—or on other non-ferrous metal joining work. Write for Bulletin EW-58.

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Field Reports on Business

Backlog of orders received by electrical manufacturers has been further increased by demands from government sources. Utilities and industrials are buying a variety of electrical equipment. Several new turbo-generators have been ordered and more are on schedule.

NEW YORK

Electric utilities report continued growth in power loads and revenues, but higher taxes have cut net earnings. Plans are under way for new generating capacity, with work now under way being speeded to meet anticipated defense loads.

Retail demand for major electric appliances continues heavy. The selling season has been extended. Consolidated Edison starts a new appliance drive.

Manufacturers are "farming out" more work to meet production schedules on defense orders. General Electric reports that 400 concerns are working with the company in a $20,000,000 effort.

Copper has been placed under 100 percent priorities control by the OPM. Indications are that other metals will be placed under stricter priorities in the near future.

Business in this area continued at a fast pace, with a variety of electrical equipment being ordered by industrials and utilities. Home building is expanding to house defense workers.

In the Pittsburgh area the Bureau of Business Research of the University of Pittsburgh reports that the adjusted volume of production remained unchanged during the past week. Activity is well above a year ago.

Engineering News-Record reports construction awards of $173,094,000, 93 percent above a year ago.

NEW ENGLAND

Two 10,000-kw. Allis-Chalmers steam turbo-generators have been ordered for a new $2,500,000 plant at Westerly, R. I., by the Narragansett Electric Co. Cambridge (Mass.) Electric Light is expending $517,300 on system improvements, including $273,600 for additional cable ties.

Government awards for this area announced for last week included $1,645,769 to United Aircraft Corp. for engines and parts; $2,319,660 to Sargent Co., New Haven, Conn., for fuses; $8,048,986 Scovill Manufacturing Co., Waterbury, Conn., material, and $523,792 Gilbert-Barker Manufacturing Co., West Springfield, Mass., water jackets. Westover Field, Chicopee, Mass., is to have a new radio station and radio range building at a cost of $55,954; lighting systems are to be constructed at Hillsgrove Airport, R. I., involving $10,871, and at Lebanon, N. H., $18,564. Fairbanks Morse Co. has sold pumping equipment for Lowell (Mass.) pumping stations totaling $87,532.

Store renovations in the Boston downtown district are progressing. A 40-hp. air-conditioning unit, 22 hp. in miscellaneous small motors and 40 kw. in fluorescent and special lighting effects are numbered among the new features to be installed in a prominent Boston store. Commercial cooking apparatus sales are encouraging and infra-red equipment is attracting attention.

American Bosch Corp., Springfield, Mass., has been granted a lease agreement addition of $2,118,608 by the Defense Plant Corporation for acquisition of land, erection of buildings and the purchase of machinery. Wico Electric Co., West Springfield, Mass., has completed the construction of a $50,000 addition.

Eastern Massachusetts residential construction is advancing and major electric appliances are receiving encouraging attention as the result of this trend and the unusually stable employment conditions.

PACIFIC COAST

Returning coast representatives from summer conferences of various appliance manufacturers bring reports which tend to discount recent scare-headlines of a 50 percent production cut. Such statements, they say, are unauthorized and thus for unwarranted, though they are warning their dealers to expect only a portion of their major appliance orders, especially refrigerators.

The past week has been featured by exceptionally heavy machinery awards for the Grand Coulee plant, including $2,697,785 to Westinghouse for three 108,000-kva. generators, $1,880,000 to Newport News Shipbuilding Co. for three 150,000-hp. turbines and $82,992 to Woodward for governors. Other orders cover $61,000 insulators and $25,000 cable for Parker Dam, 3,030 fir crossarms for the 115-kv. Coulee-Spokane line, $40,503 to Bethlehem for a Bonneville steel substation and a $199,000 award for central steam plant at Ogden army air base.

Electrical orders for various shipyards cover $19,000 crane and pump motors and 37 capacitor equipments, costing $31,000, for Richmond and $50,000 transformers for Mare Island. Recent Hawaiian Island orders include a 400-kw. turbine set, value $22,000; miscellaneous motors, size 5 to 50 hp., $10,000, and a $35,000 varied equipment Pacific Island installation.

Pacific Gas & Electric Co. recently ordered $45,000 of 667-kva. transformers. New coast industrial developments cover a cement plant at Goldfield, Nev., and electric steel rolling mill at Portland, Ore., the $350,000 National Automotive Fibre factory in San Leandro and a Bendix $500,000 addition at Hollywood, both California.

CHICAGO

What is behind the continued pick-up in retail sales during the first half of the year is revealed in the monthly review of the Federal Reserve Bank of Chicago, just issued. Chicago area jobs and payrolls reached an all-time high last week.

Study of electrical permits issued by the city of Chicago shows a steady increase of good proportions month by month. Wiring extensions, electric signs, ranges, water heaters and a flood of small motors make up the total. A well-sustained period of 10 to 20 deg. above normal temperatures cleared out wholesalers and dealer's stocks of fans and room coolers lunged ahead to a new record. The Department of Public Works is calling for bids on 300,000 feet of single-conductor No. 8, rubber-insulated lead-sheathed, 1,500-volt taped parkway cable. National defense contracts valued at $27,540.000 were placed with Chicago area companies during the week ended July 26.

Illinois radio and appliance dealers are developing a campaign to take the fullest advantage possible of the recently enacted "industrial selling bill." Commonwealth Edison Co. announces, effective August 16, an increase of minimum down payment to 10 percent on installment purchases. Maximum term for refrigerators will be reduced from 30 to 24 months.

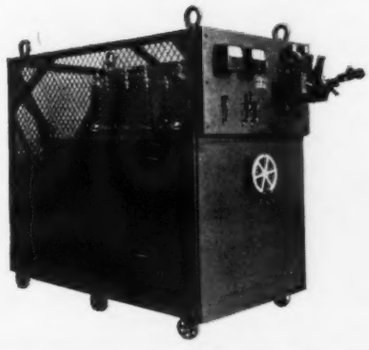
AMERTRAN TRANSFORMERS

Portable set designed to permit laboratory tests on transformer oil in the field — AmerTran Type TS-6D.

The importance of dielectric tests on insulation and equipment at regular intervals and with *dependable* apparatus cannot be overestimated. Such tests not only are your best insurance for uninterrupted service but also are essential for the protection of human life and valuable property.

For four decades many leading electric utilities, equipment manufacturers, universities and testing laboratories have depended upon AmerTran for high-voltage testing apparatus. During this time our engineers have thoroughly studied testing problems of all types and have developed transformers and complete sets for both light- and heavy-duty testing. Standard designs are available to meet the most specialized requirements of the research worker, commercial testing laboratory, maintenance man and electrical manufacturer.

Heavy Duty test set for the commercial laboratory, utility or manufacturer; 10 Kva., 100 Kv.— AmerTran Type TS-10A.



Consult with AmerTran on all problems involving equipment for testing electrical insulation, whether it be paper, tape, oil, rubber and pressboard in the pre-fabricated state or in assembled products such as motors, generators and cables. Let us submit complete data on apparatus for your needs.

AMERICAN TRANSFORMER COMPANY
178 Emmet St., Newark, N. J.

AMERTRAN

NEWS ABOUT PEOPLE

International Utilities Elects Yeager Head

William B. Yeager, vice-president and director of International Utilities Corp., has been elected to the presidency of that organization to succeed P. M. CHANDLER, who resigned as president and chairman. Mr. Chandler will continue as president of General Water Gas & Electric, which is a subsidiary of International.

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▶ LEE C. MCCLURKIN, for the past two years vice-president of the Arkansas Utilities Co. and general manager of the plant at Helena, Ark., has been elected president of the company. He has been with the company and its affiliates a number of years. At one time he was general sales manager of the Texas-New Mexico Utilities Co.

▶ R. HALL, secretary of the Electrical Service League of British Columbia and illumination engineer for the British Columbia Electric Railway Co., has been ordered to take a complete rest and has been granted leave of absence from all duties.

▶ ROBERT H. FITE, JR., head of the sales department of Ebasco Services, Inc., has joined the operating consulting group. WILLIAM E. PARROTT, who has been chief sales sponsor for Ebasco, succeeds Mr. Fite, while F. W. OHLES, head of the sales consulting group, becomes chief sales sponsor. The new head of the sales consulting group is H. W. BRUSMAN, who has been sales sponsor for the South Central group of Electric Bond & Share operating companies.

▶ HOWARD BOYLAN, assistant to the president, California Electric Power Co., has been elected a vice-president, according to an announcement by A. B. West, president of the company. Mr. Boylan will continue with past duties in his new capacity, and will also have general supervision of work now being carried on to effect reduction of operating expenses, and securing increased efficiencies and economies in all departments of the company.

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T. G. Dignan New President of New England Utility

Thomas G. Dignan, whose election to the presidency of the New England Power Service Co., a subsidiary of the New England Power Association, was recently announced by President Carl S. Herrmann of the parent organization, is

one of the most prominent of the younger executives in public utility work in the northeast. He was born at Wakefield, Mass., in 1899, was graduated from Holy Cross College in 1921 and from Boston University Law School in 1924. Mr. Dignan has served in many branches of the industry during his connection with the New England Power System. He has been a member of the association's legal department, secretary of the association, manager of the Lowell Electric Light Corp., and for seven years was vice-president and general manager of the Worcester County Electric Co., becoming president of that utility last winter. Among his responsibilities at Worcester are listed charge of operations of the Worcester Suburban Electric Co., Spencer Gas Co., Milford Electric Light & Power Co. and the Union Electric Light & Power Co. of Franklin, Mass., and the presidency of the first three utilities. President Herrmann said in connection with Mr. Dignan's promotion that "Mr. Dignan's background of practical operating experience splendidly equips him for a position of this importance."

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▶ GEORGE BARNARD, New Castle attorney, has been appointed a member of the Indiana Public Service Commission, succeeding MOIE COOK, Logansport.

▶ WILLIAM B. HIMROD, vice-president of the Los Angeles Board of Water and Power Commissioners, has resigned because of the demands of private business. He is senior partner in the law firm of Himrod & Parks. His term would have extended to July 1, 1942.

▶ CLAIR F. BOWMAN of Helena, Mont., has been appointed assistant chief engineer to the Maryland Public Service Commission. Mr. Bowman, who has been chief engineer of the Montana Public Service Commission, will fill the vacancy which has existed since last April, when Charles E. Thornton resigned to join an engineering firm. He served as chairman of the Montana section of the American Institute of Electrical Engineers in 1939 and 1940.

▶ HOWARD J. TAIT has been appointed works manager at the Newark, Ohio, factory of the Holophane Co., Inc. A graduate of Western Reserve University and Case School of Applied Science, Mr. Tait was initially employed by the Holophane Co. at its New York City office and in Newark, Ohio, in 1910, and was with the Ivanhoe division of

under thousands of
"heavy traffic" streets like this

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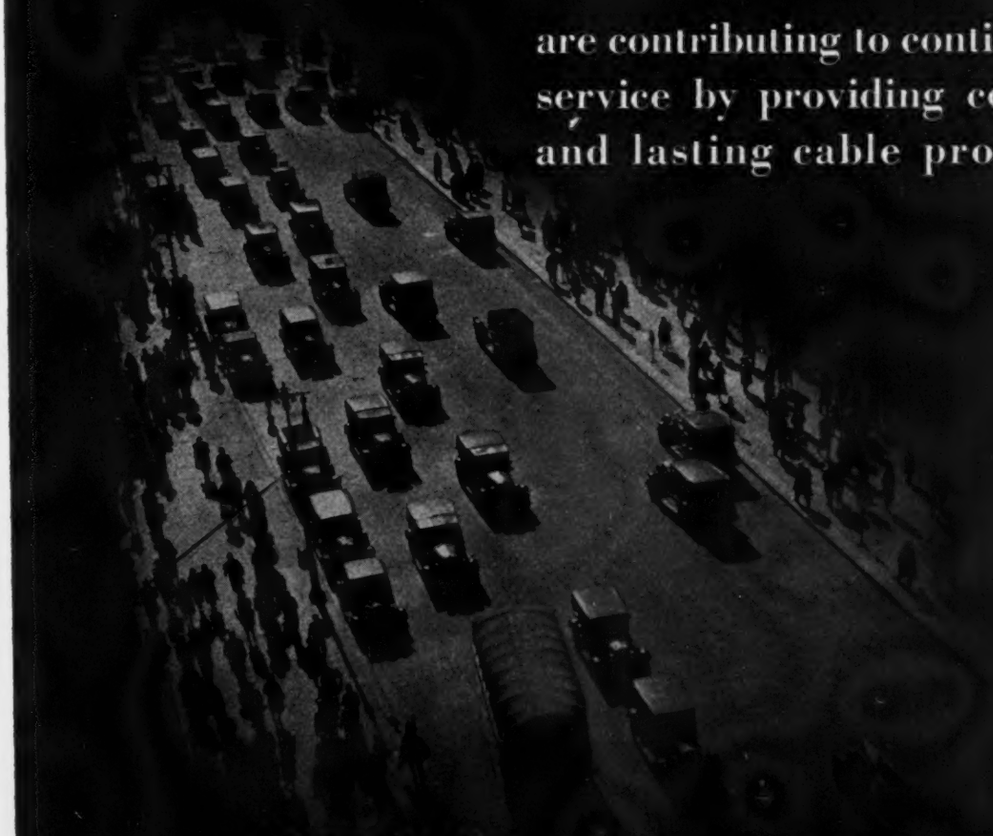
are contributing to continuity of service by providing complete and lasting cable protection



ORANGEBURG *Standard* for installation *with* concrete encasement
NOCRETE for installation *without* concrete encasement

ORANGEBURG HAS BEEN A LASTING NAME "UNDERGROUND" FOR 49 LONG YEARS

Photograph by Nesmith

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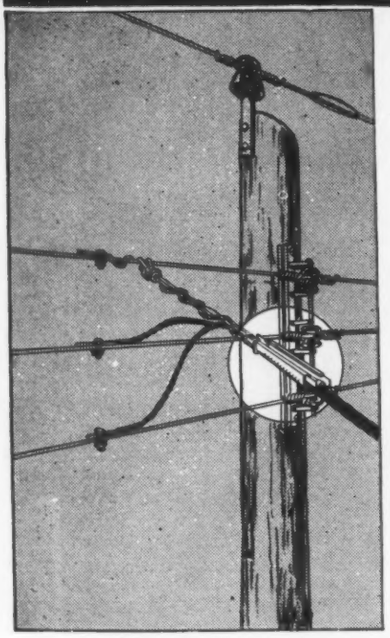


Residential area construction—showing single phase primary with attachment of service cable a couple of feet from pole to high strength common neutral wire.

RELIABLE
CONCENTRIC
CABLE CLAMPS

hold cable securely without bending or snubbing or otherwise damaging the insulation. Non-corrosive materials — easy to install — low in cost.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
3143 CARROLL AVENUE · CHICAGO ILLINOIS

General Electric from 1916 to 1926. For a period of four years after, he served as factory superintendent for the Miller Co. in Meriden, Conn., and rejoined the Holophane organization in 1930.

▶ EMBREE D. WILSON has taken over the position of general superintendent of the Southern Nevada Power Co. at Las Vegas. Mr. Wilson has been associated with the Utah Power & Light Co. for nineteen years and was engineer for the Salt Lake division when he resigned.

▶ MELVIN L. ARNOLD, for the past six years associated with Jos. R. Gerber Co., a Portland advertising agency handling the Portland General Electric Co. account, has been appointed acting advertising manager for the utility. While with the Gerber Company Mr. Arnold worked on the company account and prepared much of its advertising copy. He succeeds RALPH MILLSAP, who, holding a commission in the Naval Reserve, was recently ordered into active service at Annapolis.

▶ FREDERICK J. RUDD, managing engineer of the motor department, General Electric Co., Lynn, Mass., works, was presented with a wrist watch by fellow executives at a recent dinner in honor of his completion of 40 years of service. Mr. Rudd entered the company's employ in 1901 following completion of a college course in electrical engineering, and served as assistant managing engineer of the motor division at the River Works for several years before assuming his present post.

▶ C. J. COWARD, advertising and sales promotion manager Nash-Kelvinator Corp., will serve as chairman of the Modern Kitchen Bureau electric range committee for 1942. Active in the work of the MKB during the past four years, Mr. Coward was appointed chairman of the plan committee last year.

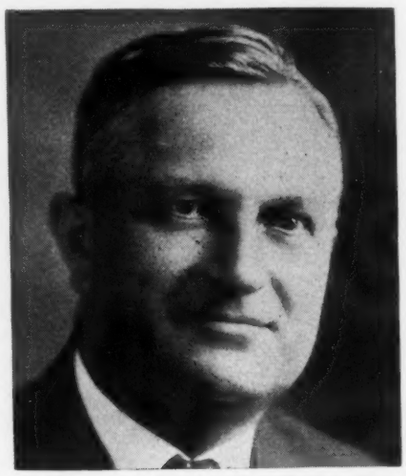
▶ CLARENCE H. OSHA, formerly with the Wisconsin Electric Power Co. at Milwaukee, has been named manager of the new business and industrial power departments of the Indiana Service Corp. at Fort Wayne, succeeding L. W. Warner, resigned. Mr. Osha was graduated from Purdue University in 1924, joining the power sales division of the Milwaukee utility that year.

▶ C. G. SKIDMORE, specialist on motor control for power plants, has been transferred from New York to Philadelphia, according to Cutler-Hammer, Inc. Prior to his association with Cutler-Hammer, Mr. Skidmore was employed by the U. S. Bureau of Reclamation as a design engineer on control for power plant equipment.

OBITUARY

Harvey C. Couch

Harvey C. Couch, utility magnate and industrialist, whose death was announced in the August 2 issue of ELECTRICAL WORLD, page 10, was an outstanding figure in the public utility industry in the Southwest and the organizer of three large power and light companies—Arkansas Power & Light, Louisiana Power & Light and Mississippi Power & Light. At the time of his death he was head of the Arkansas Power & Light Co. and Kansas City



Southern-Louisiana and Arkansas Railway lines.

In addition to the utility and rail companies which he headed, Mr. Couch had many other interests. He was a director of the Reconstruction Finance Corporation from 1932 through 1934, and at the time of his death was a director of the 8th District Federal Reserve Bank of St. Louis. He served as fuel administrator for Arkansas during the World War, was chairman of the Arkansas Red Cross in 1927, the Arkansas Flood Control Commission in 1927 and the Arkansas Drought Relief committee in 1930.

Mr. Couch was born at Magnolia, Ark., on August 21, 1877, and his boyhood was spent on a farm in the southeastern part of that state. He conceived and built the first rural telephone line in southeast Arkansas and north Louisiana. Later he extended the system through Louisiana to Texas and Oklahoma. He entered the electric power field in 1913, with J. L. Longino and other associates, organizing the Arkansas Light & Power Co. at Arkadelphia and building the first transmission line in Arkansas. He and his associates built the first major hydro-electric plant in the state. By 1926 the company was serving a large part of the state and in that

year it was reorganized as the Arkansas Power & Light Co. The system is now interconnected with the Louisiana Power & Light and Mississippi Power & Light companies, sister companies. Mr. Couch organized all three companies, resigning as president of the Mississippi and Louisiana systems in 1936.

Upon his return to Arkansas following resignation from the FRC, he immediately had the power companies which he headed develop a new type of rural line and undertook an extensive rural electrification program. When he returned to his native state he was honored by citizens of the entire state in a "Harvey Couch Day" program at Pine Bluff, with senators, congressmen, the Governor and leaders from every section present.

Mr. Couch was active in the old National Electric Light Association, having been president of the southwestern division. He had served on the board of trustees of the Edison Electric Institute for a number of years and was serving at the time of his death.

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Ralph M. Walker

Ralph M. Walker, president of the Walker Electrical Co. of Atlanta, Ga., died on July 30. In 1939 the Walker Electrical Co., which for many years had been one of the leading electrical contracting firms of the East and South, and also was engaged in the manufacture of switch and panel boxes, reorganized. The Walker Electrical Co. incorporated as a separate manufacturing business with Mr. Walker as president and the contracting business was transferred to a new company, the White Electrical Construction Co. At the annual convention of the National Electrical Contractors Association held in Philadelphia in 1939 Mr. Walker received the James H. McGraw Award Contractor-Dealers Medal "in recognition of his contribution to the advancement of the contracting branch of the electrical industry, through his long and consistent promotion of a better understanding among electrical men of the principle underlying fair trade policy and the practical benefits of fair dealing."

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▶ Prof. Frederick W. Hehre, head of the department of electrical engineering at Columbia University, died suddenly on July 27 at Martha's Vineyard, Mass., where he was spending his vacation. He was 50 years old. Professor Hehre became head of the electrical engineering department at Columbia last May to succeed Prof. Walter I. Slichter who retired in June. Professor Hehre is a fellow of the American Institute of Electrical Engineers.

What do you look for in CELL-STRUCTURE MATERIALS?

TOLEDO EDISON CO., Toledo, Ohio. Shown here are bus housings of J-M Trancell. Large photo shows the easy, clean way in which Trancell is installed; inset shows neat appearance of finished structures.

SAFETY? Cell structures of J-M Trancell minimize fire damage. An asbestos product, Trancell cannot burn . . . confines fires to the cells in which they start. Transmitted heat from such fires is virtually no problem, because Trancell has a low heat conductivity compared with metal.

LOW MAINTENANCE? Cell structures of J-M Trancell require little if any upkeep. Trancell cannot rust or rot . . . minimizes condensation troubles . . . virtually eliminates shutdowns for cleaning or painting. And its light weight makes it possible to protect high-voltage equipment on balconies with less danger of overloading floors.

EASY INSTALLATION? Trancell is supplied in prefabricated sheets, factory-cut to the exact sizes needed. Assembly can be quickly accomplished by any handy man, with ordinary tools. A complete line of hardware for Trancell doors is available.

For full details on Trancell, write for engineering brochure DS-426. Johns-Manville, 22 East 40th St., New York, N. Y.

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Novel Scheme Coordinates Relays and Fused Taps

[*Continued from page 75*]

timing for a fuse will allow for manufacturing irregularities and changes in ambient temperature. System setups of this kind are far from being ideal from the viewpoint of the relay and fuse coordinating engineer. However, it is possible by developing proper relay arrangements and proper rating and selection of fuse characteristics to obtain selective coordination.

Characteristic Differences

Relays and fuses always have different time-current characteristics, and in the development of a coordination with absolute selectivity it is practically necessary to construct time-current coordination curves by spot checking. Spot checks a little high in time on the knee of the relay curve should be close together. The relay and fuse curves are usually close in that section when the fuse is on the load side of the relay. Time-current curves of relays and of fuses drawn on cross-section paper, each with the same proportional spacing for time and percent current values, will aid in quickly determining relay and fuse coordinations.

Time-current curves illustrating coordination obtained for stations No. 1 and No. 2 for phase faults and for line-to-ground faults are shown on Plates I and II.

Installation of the instantaneous relays represented in Plate I, curve A, is optional, depending on the desirability of rapidly clearing high fault currents. Relays represented by curve B are instantaneous over-current relays with the trip circuit connected through an auxiliary relay as shown in the relay circuit diagram. The definite time delay indicated by curve B permits clearing of faults over a large portion of the line in a short time interval, maintaining selectivity with the fuse at station No. 2 for faults far into the transformers. Curve C indicates the protection given by the time over-current relay which has the characteristic of inverse time over a wide current range and provides protection for the entire length of line exposure. Curve C_1 indicates the protection given by a time over-current relay which has inverse, definite time characteristics. The relay in the current residual circuit will provide more sensitive protection for line-to-ground faults.

Maximum fault current value for line-to-ground faults cannot be predicted with a high degree of accuracy by calculation. Therefore, if instantaneous elements are used in the ground relays and actual line fault tests have not been made it will be advisable to set pick-up of the instantaneous elements considerably higher than calculated line to ground fault current values at station No. 2. Since ground relay and fuse coordinations depend on primary ground faults quickly developing into high current faults it is essential that station grounding of the steel structure, transformer cases, oil switch frames and all other equipment be of low resistance and capable of carrying heavy currents. Dependable ground relay and fuse coordinations may then be developed for voltages of 19 kv. line to ground and higher.

Coordination

Referring to Plate III, time-current curves are shown which illustrate the coordination obtained for station No. 2 and the 6.9-kv. line fusing. No difficulty is experienced in coordinating the 400-amp., 2.3-kv. fuse with the 200-amp., 35-kv. fuse because of the wide difference in kva. ratings. In this case if an automatic reclosure is not used on the 6.9-kv. oil switch "A" in the system diagram, the 0.2 second time differential between contact closing time of the inverse definite time relay (curve C) and the 400-amp., 2.3-kv. fuse blowing time, curve A, is not sufficient to assure selectivity. Therefore it will be necessary to use an instantaneous over-current element to obtain selectivity and retain coordination with the line fuse.

Referring to curve C_1 for an over-current relay which has inverse timing over a wide current range, a selective coordination is indicated without the use of an instantaneous element. With an automatic reclosure added to oil switch "A" the heating of the 2.3-kv. primary fuse must be taken into account in relay operations immediately following a reclosure. The differential in relay and fuse timing necessary for correct selectivity will depend on a balance of the heating and cooling cycles of the fuse with another factor including the reset time of the relay if the reclosing time is short. For these reasons the instantaneous over-current relay ele-

ment will be necessary to assure proper coordination when a reclosure is used on switch "A."

Auxiliary Relay

The auxiliary relay shown in the relay circuit diagram, and which may be used to shorten the clearing time in relay and fuse coordinations as demonstrated in Plate I, probably should be described a little more in detail.

A relay which has been found to give very dependable timing up to 0.5 second is a type HGA, 125-volt, d.c. relay with adjustable magnetic air gap and contact gap (double break). The magnetic air gap at the center of the pole piece was adjusted to 0.054 in. and an adjustment was arranged to limit the freedom of the contact strips from the armature to give a contact gap of 0.057 in. A 100-mf. condenser was used in parallel with the coil and a 3,900-ohm resistor in series as shown in the diagram.

It will be noticed on the relay circuit diagram that when an instantaneous over-current relay used for definite time protection operates to close contacts the condenser in parallel with the auxiliary relay coil is charged at a rate depending on the amount of resistance in series. The auxiliary relay cannot pick up until the condenser has charged up to the necessary voltage for the relay setting used. The auxiliary relay is free of practically all mechanical over-travel due to inertia, since the timing is due to the relation between the capacitor and the resistor. Therefore, if the over-current relays drop out due to coordinated station fuses blowing and clearing the fault, the timing cycle of the auxiliary relay will immediately stop. Due to the auxiliary relay contact gap, a slight over-travel may occur, but this cannot cause faulty coordination with the contacts of the auxiliary relay and the over-current relay in series.

Definite Time

The definite time protection can be used in coordination with fuses on tap lines as well as with fuses on transformer banks. In case the d.c. control voltage should temporarily drop, the only effect will be to lengthen the time of operation without affecting selectivity.

It is not necessary to consider the full direct-current offset component of fault current in developing coor-

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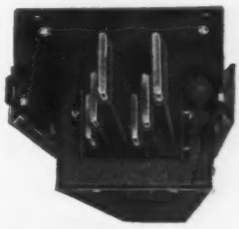

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dinations of relays and one shot fuses where the fuses are connected in the system on the load side of the oil switch. This is because system faults rarely develop at the zero voltage point of the alternating cycle, either from mechanically started faults or lightning, and the superficial inspection obtained at the time of refusing reveals a condition causing a short circuit of maximum current proportions. For a more thorough discussion of the presence of the d.c. offset component in system faults refer to G.E. "Relay News," November, 1936, and April, 1937.

LETTERS TO THE EDITOR

"Flammable" and "Non-Flammable"

To the Editor of ELECTRICAL WORLD:

I have been quite interested in the editorial "Of Words and Engineers," appearing in the ELECTRICAL WORLD, June 14.

The correspondent who takes "violent exception" to the use of the word "flammable," and who, in the words of your editorial, "asserts there is no such word in any dictionary and that its coinage is unfortunate," starts off on a false premise.

All dictionaries that I know of, including Webster's, Century, Standard and Oxford (in both new and old editions), include "flammable," and as the word is to be found in English literature for over three hundred years it can hardly be referred to as "coined."

A careful discrimination in the choice of words should characterize engineering and technical writing. Due to the unfortunate formation of "inflammable" and "uninflammable" and their relationship to "combustible" and "incombustible," "flammable" and "non-inflammable" have been adopted by the National Fire Protection Association and others as words which cannot be misunderstood.

Perhaps some of our Latin scholars can explain why two words "flammare" and "inflammare," seemingly identical in meaning, should have been carried over into the English language to bother us.

In all technical writing and for caution signs it seems to many of us that only "flammable" and "non-flammable" are justifiable, since they cannot be misunderstood.

This discussion could be considered academic, were it not for its relation to safety work where many people of foreign birth or extraction, with a limited knowledge of English, easily may be confused by such words as "inflammable" and "incombustible."

Yours for the disappearance of "in flammable" from all technical writing.

HERVEY S. VASSAR,
Bloomfield, N. J.

•

N.F.P.A. Advocates Use of "Non-Flammable"

To the Editor of ELECTRICAL WORLD:

The editorial in the June 14 issue of ELECTRICAL WORLD "Of Words and Engineering" was read by me with interest because it is my recollection that many years ago the amount of confusion existing among laymen on the real meaning of the word "inflammable" caused the National Fire Protection Association to advocate the use of the terms "flammable" and "non-flammable," and for many years we at Underwriters' Laboratories, Inc., have been inclined toward that use.

The reason for this, oddly enough, is the very reason that Mr. Brown advances in support of his contention that "flammable" should never be used, and that is the two meanings of "in" as a prefix. The more common use of "in" in this connection is "not"; for example, "incombustible," "inconsolable," "inadequate."

While I do not pose as a profound student of the English language, it is my belief that it has been considerably enriched by changes that have occurred over a long period of years, and a few more changes in the interest of clarity, assuming clarity is the result, seem to me to be warranted.

M. M. BRANDON,
Associate Electrical Engineer
Underwriters' Laboratories, Inc.,
New York City

•

Legally Enforceable Lighting Codes

To the Editor of ELECTRICAL WORLD:

Your editorial on this subject appearing on page 68 of ELECTRICAL WORLD for May 3, 1941, deals with an aspect of lighting which is well known to the comparatively few who are familiar with light, vision and the human "seeing" process. The great majority, however, who so unconcernedly take light for granted, are unaware of the enormous loss to business and of the high toll paid by society in general from the lack of adequate lighting.

At least one country has done something to improve the situation, enacting a legally enforceable lighting code that

is reasonable, quite complete, concise and understandable. The country is Spain, and the code appears in the Official Bulletin of State, issue 242 of August 29, 1940, on page 5991, under an order of the Minister of Labor, whereby "standards of illumination are established for work centers."

The Spanish Luminotecnical Association, which occupies a position in Spain analogous to that of the Illuminating Engineering Society in the United States, was instrumental in the adoption of this code, chiefly through the untiring efforts over a period of many years by the association's engineering director, Eduardo Carvajal. According to Senor Carvajal, this is the first legal, enforceable and specific lighting code to be published in Europe.

The undersigned can assure you, by virtue of first-hand knowledge of lighting conditions in Spain, that the provisions contained represent a great stride forward toward lighting adequacy. Since legal documents are notoriously poor media for educational purpose, of interest also is a publication by the same Ministry of Labor entitled, "Lighting" (Alumbrado), printed for general distribution. A reproduction of this article appears on page 14 of the edition "Prevencion de Accidentes" for October, 1940, which is the official organ of the Inter-American Safety Council.

P. H. WHITMORE,
Assistant Commercial Manager
Compania Cubana de Electricidad,
Havana, Cuba.

•

Georgia Power Salesmen in Subcontracting Survey

To the Editor of ELECTRICAL WORLD:

We enjoyed very much your editorial page in the July 12 issue of ELECTRICAL WORLD.

Your thinking regarding "Power Salesmen Can Bird Dog Subcontracting Shops" makes sense. Several months ago, when this idea apparently was just getting started, we may have been a sort of guinea pig, for the reason our boys made a complete survey in conjunction with a representative of the Federal Reserve Bank and it has been productive of good results.

EDWIN M. CLAPP,
Manager Power Sales Div.,
Georgia Power Co., Atlanta

•

PUD Seeks REA Funds

Snohomish County PUD, Everett, Wash., has made application for REA funds to serve 365 applicants in marginal territory with 150 miles of power lines; 140 additional prospective customers are along the lines.

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OIL STOP is a phenol-aldehyde synthetic resin which has many uses in the electrical industry for cable splicing, low cost oil tight terminals, stop joints, insulating buses, cementing transformer gaskets, repairing cracked bushings, coil sealing, waterproof coatings, etc.

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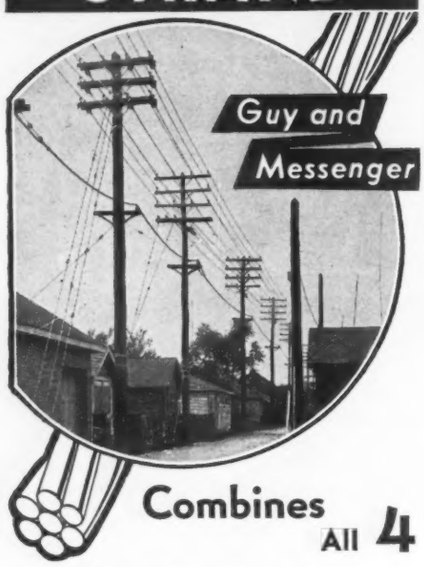

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Sales Opportunities

DALLAS, TEX.—Dallas Power & Light Co. is considering preliminary plans for expansion at Mountain Creek generating station, with installation of equipment to double present capacity. Work will include enlargement of switchyard and extensions in transmission lines, and will require close to 24 months for completion. Cost estimated about $2,200,000.

GREENSBURG, KAN.—Department of Public Utilities, William Atkinson, superintendent, plans expansion and improvements in municipal power plant, including installation of additional equipment for increased capacity. Estimates of cost are being made.

DUNKIRK, N. Y.—Allegheny-Ludlum Steel Corp., Oliver Building, Pittsburgh, Pa., plans installation of motors and controls, transformers and accessories, switchgear, duct lines, industrial lighting system, conveyors, electric hoists and other equipment in new one-story plant unit at mill at Dunkirk, to be used for production of alloy steel rods and allied specialties for Government. Superstructure is scheduled to begin at once. Entire project will cost about $4,000,000, and appropriation in that amount will be secured through Defense Plant Corporation, Washington, D. C., a Federal agency, for building, machinery and equipment.

EUGENE, ORE.—Lane County Electric Cooperative, Inc., Odd Fellows Building, Eugene, will take bids soon for three electric power substations at Cottage Grove, Crow and Creswell, Ore., in connection with construction of about 334 miles of transmission and distributing lines, for which bids will be asked at same time. Also, will call for bids for new 33,000-volt transmission line from Eugene to Drain, Ore., about 42 miles. System will be connected with Bonneville high-tension lines, which will furnish power supply for distribution. John W. Cunningham & Associates, Spalding Building, Portland, Ore., are consulting engineers.

PHILADELPHIA, PA.—Philadelphia Electric Co. will soon begin work on steel frame superstructure for new Southwark steam-electric generating station, Delaware Avenue and Porter Street. Initial structure will be close to 200 x 400 feet, equivalent in height to a 12 to 14-story building. Plant is scheduled for completion in fall of 1943.

NEW YORK, N. Y.—Consolidated Edison Co. of New York, Inc., has filed plans for alterations and improvements in steam-electric generating plant at 666-80 First Avenue. No estimate of cost announced.

TEXARKANA, TEX.—Lone Star Defense Corp., care of B. F. Goodrich Co., Inc., Akron, Ohio, manufacturer of rubber goods, recently organized as a subsidiary interest, plans installation of motors and controls, transformers and accessories, switchgear, interior and exterior lighting systems and facilities, duct lines, conveyors and other equipment in new plant on 24,300-acre tract of land near Texarkana, for bomb and shell-loading for Government. It will comprise a series of one and multi-story buildings, equipped for large output. A power substation will be located at plant site for central station service. Work will begin at early date. Cost $33,500,000, including land, buildings and equipment, with appropriation of such amount to be furnished by Defense Plant Corporation, Washington, D. C., a federal agency, for project.

CLAYSBURG, PA.—Pennsylvania Edison Co., Altoona, Pa., has approved plans for new power substation at Claysburg, including extensions in transmission lines in that district. Proposed to begin work at once.

MCCOOK, NEB.—McCook Public Power District, McCook, plans extensions in primary and secondary lines in parts of Frontier, Redwillow and Hitchcock Counties, totaling close to 100 miles, with power substations and service facilities. Cost close to $125,000. Financing has been arranged through Federal aid and work is scheduled to begin soon.

FORT MYER, VA.—Construction Division, Office of Quartermaster General, Fort Myer (Washington, D. C., district), plans power plant in new three-story office building for War Department on site of Agricultural Experiment Station, Arlington County, Va., near District of Columbia line, recently acquired for that purpose. Structure will total about 4,000,000 square feet of floor space, and will be the largest office building in the world, it is stated, with accommodations for 30,000 persons. Installation will include escalators, instead of elevators, for all floors; air-conditioning plant and system; fluorescent lighting system and complete electrical facilities throughout. Appropriation of $35,000,000 is being arranged for structure. Edwin Bergstrom, 3757 Wilshire Boulevard, Los Angeles, Calif., is architect.

CHICAGO, ILL.—Commonwealth Edison Co. has approved plans for a three-story addition to indoor power substation at 6405 School Street, 33 x 48 feet, and will proceed with work at once. Transformers, switchgear and auxiliary equipment will be installed for increased capacity. Cost reported over $80,000. Company also has asked bids for alterations and improvements in turbine room at Northwest generating station, 3400 North California Street, and will award contract soon.

SEATTLE, WASH.—Puget Sound Power & Light Co. has authorized construction of three new power substations for extensions in service in Northern District, King County, near city, to be located at North 145th Street and Aurora Avenue, 3002 East 145th Street, and 2333 East Ninety-fifth Street, respectively. Work will be carried out at once.

LOS ANGELES, CALIF.—Bendix Aviation, Ltd., Union Air Terminal, Burbank, Calif., manufacturer of aircraft instruments and parts, plans installation of motors and controls, transformers and accessories, switchgear, fluorescent lighting system, duct lines, conveyors and other equipment in new plant at 11600 Sherman Way, North Hollywood, Los Angeles. It will consist of three main units, with largest structure to be one-story, 240 x 350 feet. Power substation facilities will be provided for central station service. Cost close to $500,000. Work is scheduled to begin at early date. H. L. Gogerty, 1717 North Vine Street, Hollywood, is architect.

Gets Turbine Order

The Newport News Shipbuilding & Dry Dock Co. has received orders for three 150,000-hp. turbines, on bid of $1,880,000, for installation at Grand Coulee.

Recent Rate Changes

PHILADELPHIA ELECTRIC CO. has been ordered by the Pennsylvania Public Utility Commission to file with it on or before August 18, tariff schedules designed on the basis of consumer consumption studies for the year ended May 31, to effect an annual reduction in gross electric operating revenues of not less than $4,000,000. The new tariff schedules are to be effective for all billings resulting from meter readings after August 31. In June the utility offered to reduce its rates $4,000,000 annually and the commission accepted the offer (ELECTRICAL WORLD, June 28, page 64). When the company files its schedules, the inquiry instituted by the commission after prolonged negotiations will have been terminated.

CONNECTICUT LIGHT & POWER CO. has established a new household service rate effective in the New Britain, Bristol, Meriden and Waterbury districts with the exception of the towns of Oxford, Sudbury and Woodbury. Under this the first 6 kw.-hr. or less are sold for $1 minimum charge per month, the next 64 kw.-hr. for 3.5 cents each, and all over 70 at 2.5 cents each. The rate applies to single-phase electric service for year-round use by single families occupying dwellings on "suitable distribution lines or on extensions along the highway in accordance with the extension clause." The former rate stopped at 3.5 cents, although another rate existed for householders using well above the average.

SOUTH CAROLINA UTILITIES CO. rates have been cut by $8,000 to $10,000 a year, according to an announcement by Robert M. Cooper, general manager of the South Carolina Public Service Authority. The Authority purchased the South Carolina Utilities Co. last May. The reduction applies on residential, commercial and municipal services, effective on bills rendered for July, which is the first full month billing period during which the Authority has operated the property.

ABBEVILLE, S. C., hydro-electric plant customers are now paying lower rates for commercial, residential and industrial service. The new rates were authorized by the city council. The rate reduction was announced by Ward D. Carpenter, PWA acting project engineer for Abbeville, Santee-Cooper, and Buzzards Roost projects. "The new rates will enable residential consumers to install and operate economically all types of electrical appliances including water heaters," Mr. Carpenter said.

LINCOLN SERVICE CORP. electric rates for Kemmerer, Wyo., have been reduced $14,500 a year, according to an announcement by John Hancock, secretary of the Wyoming Public Service Commission. The reduced rate, applying to residential, commercial and large power users, is expected to cut the city's annual bill at least 10 percent.

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Milwaukee Liquidation

Approval of its plan for partial liquidation of capital obligations has been given Milwaukee Electric Railway & Transport Co. by the Securities and Exchange Commission. The plan calls for cash purchase, at par, of 2,000 shares of its common stock, par value $100 per share, from Wisconsin Electric Power and the redemption at par of $300,000 principal and par amount of its first mortgage 4 percent bonds.

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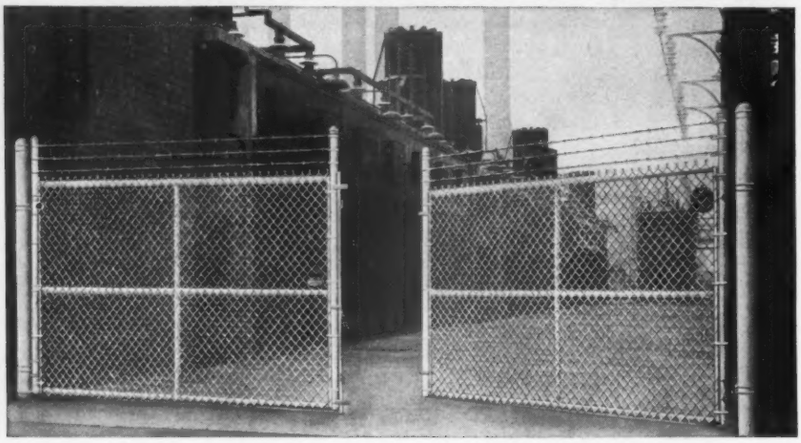

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Power Systems Get REA Allotments

Rural Electrification Administration has announced approval of allotments for loans totaling $8,478,000. These loans are made to 44 borrowers in 23 states and Alaska. One borrower is a municipality, two are power districts, and the other 41 are co-operatives formed for rural electrification. REA loans since it was created in 1935 now total $379,160,621. Among the recent allotments are the following:

ALABAMA—Tombigbee Electric Co-operative, Vernon, Robert L. Pennington, president, $400,000 to build 420 miles of line to serve 1,081 members in Lamar and Marion counties.

ALASKA—City of Kodiak, Kodiak, R. H. Chadwick, Mayor, $75,000 to build and acquire 15 miles of line, 334 members. $50,000 for construction of a generating plant.

CALIFORNIA—Surprise Valley Electrification Corp., Alturas, Jesse M. Grigsby, manager, $80,000 to build 60 miles of line, 167 members in Lake County.

COLORADO—San Luis Valley Rural Electric Co-operative, Inc., Monte Vista, Willard I. Johnson, supt., $210,000 to build 270 miles of line, 505 members in Saguache, Rio Grande, Alamosa and Conejos counties.

GEORGIA—Walton Electric Membership Corp., Monroe, John L. Shaw, supt., $134,000 to build 147 miles of line, 584 members in Walton, Gwinnett, Oconee, Morgan, DeKalb, Rockdale and Greene counties.

IDAHO—Fall River Rural Electric Co-operative, Inc., Ashton, Walter Bratt, supt., $119,000 to build and acquire 76 miles of line, 288 members in Gallatin and Fremont counties.

ILLINOIS—Edgar Electric Co-operative Assn., Paris, Wallace L. Walker, supt., $288,000 to build 299 miles of line, 800 members in Edgar, Clark, Douglas and Coles counties.

INDIANA—Southeastern Indiana REMC, Osgood, Frank E. Ratts, supt., $290,000 to build 359 miles of line, 996 members in Ripley, Dearborn, Franklin, Ohio, Switzerland, Jennings and Jefferson counties.

IOWA—Allamakee-Clayton Electric Co-operative, Inc., Postville, Kermit M. James, supt., $370,000 to build 447 miles of line, 1,011 members in Allamakee, Clayton, Fayette and Winneshiek counties.

KANSAS—Co-operative Power and Light Co., Inc., Iola, Wesley Clendenen, supt., $207,000 to build 234 miles of line, 527 members in Allen, Neosho, Anderson, Bourbon, Woodson and Wilson counties.

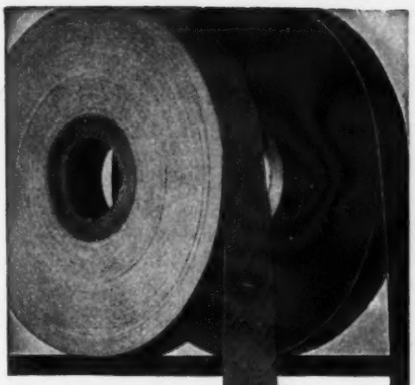
KENTUCKY—Licking Valley Rural Electric Co-operative Corp., West Liberty, Kilse H. Risner, Co-ordinator, $65,000 to build 62 miles of line, 295 members in Morgan, Breathitt, Magoffin and Wolfe counties.

LOUISIANA—Beauregard Electric Co-operative, Inc., DeRidder, Richard I. Davis, supt., $200,000 to build 212 miles of line, 695 members in Beauregard, Allen and Vernon Parishes.

MINNESOTA—P.K.M. Electric Co-operative, Inc., Warren, Victor M. Edman, president, $292,000 to build 377 miles of line, 694 members in Polk, Marshall and Kittson counties.

MISSISSIPPI—Delta Electric Power Assn., Greenwood, L. C. Spencer, supt., $160,000 to build 200 miles of line, 830 members in Bolivar, Leflore, Grenada, Washington, Sunflower, Carroll, Tallahatchie, Montgomery, Holmes and Webster counties.

MISSOURI—White River Valley Electric



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Co-operative, Inc., Hollister, Frank A. Dawes, supt., $237,000 to build 229 miles of line, 681 members in Taney, Christian, Douglas, Ozark and Stone counties.

NEBRASKA—McCook Public Power District, McCook, W. L. Search, president, $124,000 to build and acquire 101 miles of line, 219 members in Redwillow, Frontier and Hitchcock counties.

OKLAHOMA—Western Electric Co-operative, Inc., Cyril, Tom Moran, president, $500,000 for construction of generating plant.

OREGON—North Douglas Electric Co-operative, Inc., Roseburg, Robert L. Adams, supt., $380,000 to build and acquire 323 miles of line, 1,144 members.

SOUTH CAROLINA—Palmetto Electric Co-operative, Inc., Hampton, J. M. Perry, president, $153,000 to build 226 miles of line, 864 members in Hampton, Jasper and Beaufort counties.

TEXAS—Brazos River Transmission Electric Co-operative, Inc., 4613 Camp Bowie Blvd., Fort Worth, $1,300,000 for transmission lines.

VERMONT—Washington Electric Co-operative, Inc., East Montpelier, Captain Clarke Millen, supt., $10,000 to complete generating facilities.

WASHINGTON—Public Utility District No. 1 of Klickitat County, White Salmon, J. S. Degman, president, $450,000 to build and acquire 404 miles of line, 634 members in Klickitat and Yakima counties.

WISCONSIN—Waushara County Electric Co-operative, Inc., Wautoma, Edward E. Stickney, supt., $231,000 to build 295 miles of line, 621 members in Waushara, Adams, Green Lake, Waupaca and Marquette counties.

WYOMING—Hot Springs County Rural Electrification Assn., Thermopolis, C. H. Gardner, president, $88,000 to build 87 miles of line, 222 members in Hot Springs county.

REA has also announced allotments totaling $727,500 to 40 borrowers in 20 states, for relending to individual farmers to finance their installations of wiring and plumbing and their purchases of electrical appliances and equipment.

•

REA Gets $7,000,000

Allocations to the Rural Electrification Administration by the Reconstruction Finance Corporation during June were $7,000,000, out of a total allocation to governmental agencies of more than $25,000,000. Total allocations to the REA to date are $182,500,000. Repayments to date are $2,425.46.

•

Deal Made Effective

Securities and Exchange Commission has made effective a declaration of the Central United States Utilities Co. and the Pennsylvania Electric Co., regarding the issuance and sale by Pennsylvania Electric Co. of 6,873 shares of no-par value common stock to Central for $2,000,000 in cash. Pennsylvania Electric is an operating subsidiary of Central, which is a sub-holding company in the Associated Gas & Electric System.

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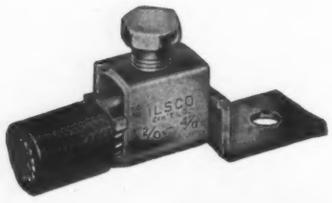

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Bangor Hydro Modernizes Plants

[*Continued from page 58*]

This last proved too coarse, producing a harsh mixture. The other sands were too fine. By producing actual concrete in the laboratory, a combination of 50 percent of the washed sand with 50 percent of another sand combined with the washed stone gave an excellent aggregate grading and the highest strength concrete, indicating that at least 3,000 lb. per sq. in. could be used for the compressive strength of concrete in design. From fourteen tests taken from actual runs on the job the average strength of the concrete which went into the structure proved to be 3,400 lb. per sq. in. The benefit of preliminary investigation was well demonstrated.

An interesting feature of the design of the concrete substructures, both at Veazie and Ellsworth, was the location of sheet copper water stops at all construction joints where it would be undesirable for water to seep into or out of the structures. Such seepage stains the concrete and spoils its appearance, particularly on outside surfaces which later tend to spall off under frost action. The Veazie extension was built under contract by Wyman & Simpson, Inc., Augusta, Me.

Ellsworth Improvements

The Ellsworth station, at the mouth of the Union River, has the benefit of the storage at Graham Lake, an artificial body of water comprising 6,000,000,000 cu. ft., the outlet dam and control being only 3 miles above the station. This plant was built about 30 years ago, the original units being of the horizontal type. Shortly after the first world war two modern vertical units were installed. In normal years stored water in Graham Lake had been utilized over a period of eight months' maximum from July 1 through the winter. During a large part of this period excess water was available at Veazie for generation and, if developed, stored water at Graham Lake could be held in reserve for increased capacity of generation over a shorter period of time. It was therefore concluded to modernize and increase the capacity at Ellsworth as fully as possible within the existing structure. With the Veazie extension this procedure would provide increased generating capacity for several years' growth.

The construction work required for the two new units decided upon at Ellsworth was performed by the forces of the Bangor company. The work involved removal to ledge of the substructure of the two old horizontal units with some additional rock excavation. The new machines are 2,500-kva. General Electric vertical generators driven at 360 r.p.m. by S. Morgan Smith wheels and operating under a normal head of 60 ft. In addition to increasing the maximum output of Ellsworth station with all units running by over 2,000 kw., the new units have provided a substantial increase in efficiency through the utilization of stored water in Graham Lake under all conditions of load. This is particularly the case at light loads, since the new units are of the automatic, adjustable Kaplan type, wherein the blades of the runners shift automatically to their most efficient position for all conditions of load.

The net result of the Veazie and Ellsworth additions and improvements has been to increase the system generating capacity by about 4,500 kw., which should provide for normal load growth to at least 1942.

Forebay Floor Rebuilt

An interesting improvement in the hydraulic layout at Veazie has been the reconstruction of the forebay floor which divides the forebay intake water above it from the tailrace discharge tunnels below. About a third of this floor was of timber construction remaining from the early days when the plant was operated as a mill. Because of failures of this floor in recent years, it was decided to replace it with reinforced concrete. A cofferdam was built across the forebay head, shutting down the entire plant. About 250 precast reinforced concrete slabs, each 18 x 20 in. x 14 ft. 6 in. long and weighing nearly 3 tons each, were placed in the forebay floor and the entire floor area under the rack structure was concreted in place. Work was carried on day and night, and when completed was a relief to the organization, because heavy rains and a flood had brought the river discharge to over 25,000 c.f.s., so that the water rose almost to the top of the cofferdam and backed up from the tailrace over the forebay floor.

Increase in the capacity of Ellsworth station necessitated changes in our 50-kv. transmission line between Veazie and Ellsworth, a distance of about 25 miles. The cost of raising the potential to 69 kv. or 110 kv. proved prohibitive on analysis. It was found that by replacing the original No. 3 solid copper conductors with No. 4/0 A.C.S.R. a greater part of the benefits of a higher voltage line could be realized at but a fraction of a cost of a new high-voltage line.

All poles which showed a remaining life of five years or less were replaced and all defective crossarms and many insulators were replaced with new ones. We have also reconstructed our Milford-West Enfield 44-kv. line to reduce losses, improve regulation and provide increased capacity of transmission.

•

City Light Merchandise Sales Total $384,011

Merchandise sales for Seattle City Light will pass the $900,000 mark in 1941, according to Superintendent E. R. Hoffman, chiefly because recent rate reductions have increased the sale of electric ranges and water heaters.

In his monthly report for May Mr. Hoffman states that electric ranges on City Light lines on May 31 totaled about 43,000 and electric water heaters more than 27,000. Total operating revenue for May was $588,143, compared with $509,265 in May, 1940. Merchandise sales reached an aggregate of $52,876 for the month, bringing the total of such sales up to $384,011 for the first five months of 1941, compared with $239,048 for the corresponding period of 1940.

•

Seeks to Sell Holdings

Denis J. Driscoll and Willard L. Thorp, trustees of Associated Gas & Electric Corp., have made arrangements, subject to court and commission approval, looking toward the disposal of the holdings of Associated Gas & Electric Corp. in Northeastern Water & Electric Corp. to Mr. John H. Ware, Jr. Mr. Ware is president of Penn-Jersey Water Co., several properties of which are located in territories adjoining those of Northeastern Water & Electric Corp. in Pennsylvania. Consummation of the sale would mean the elimination of an entire holding company system from the Associated structure.

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The moment light goes out a bell will sound its warning so that you have immediate knowledge of trouble and can save what would otherwise be a large equipment loss.

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Fuse-Contactor Combination Controls High Voltage

[*Continued from page 63*]

fuses in limited spaces. Fuse holders are locked in place in the closed position and are released and opened by means of a switch stick. When blown, high-tension fuses can be restored for service by substituting a new refill unit.

Oil-immersed contactor type motor control equipment was used on 2,200-volt circuits in conjunction with the high-voltage, high-capacity fuses. With this arrangement adequate fuse-interrupting capacity was combined with desirable long-life, low-maintenance characteristics of contactor starting at a cost under that for the alternate scheme involving circuit breakers.

Oil-immersed contactors used are capable of interrupting the full locked rotor currents of the connected motors. Contactor design provides positive contact under short-circuit conditions, as long as the holding coil remains energized, also adequate thermal capacity to carry short-circuit currents for the time interval necessary for the high-tension fuses to clear the circuit. Since the control supply for the starters is taken from the local power bus it is necessary that the control circuit be capable of holding the contactor closed during the voltage dip caused by short circuit. This is done by using a d.c. operating coil permanently connected across a dry rectifier, as shown on accompanying diagrams. During normal operation the rectifier supplies d.c. to the contactor magnet coils. On loss or dip in a.c. voltage the rectifier forms a closed path for the discharge of the contactor magnet coil energy, thus delaying the magnet release for a time interval longer than that required by the fuse to clear the circuit.

Motor Protection

Economical application of the rectifier material is accomplished by applying a high voltage to the rectifier for the time interval necessary to pick up the contactor and then, after the contactor has closed, reducing this voltage drop across the rectifier to a much lower value to provide the holding current required by the magnet.

Motor protection against overload is provided by a eutectic metal type thermal overload relay with thermal characteristics similar to those of the equipment protected. Tripping temperature is equal to the maximum average safe operating temperature of the motor windings. When equipped with heater coils for "running" motor protection this type of relay will permit a motor to start a cold machine and run at a safe overload during the warm-up period. It will also permit a motor which has been operating lightly loaded to carry a peak load beyond its rated capacity. In either case, if the overload condition persists long enough to endanger the motor the heat storage in the thermal overload relay will bring the temperature of the eutectic metal to the melting point and so allow the relay to trip.

Load Tests

Metering type current transformers are provided for the thermal overload relays and a six-pole test block with current and voltage points permits easy introduction of test instruments for load studies.

To protect the operator and the equipment against accidental opening of disconnects under load, an electrical interlock is provided which requires that the door to the high-tension compartment must be closed in order to energize the contactor.

A rear view of a 2,200-volt section cubicle, with the lower back plates removed, indicates the easy accessibility of the oil contactor for inspection and servicing. The left-hand section is a service cubicle for the group and contains the metering potential transformers and the 2,200/220-volt control supply transformer. Metering transformers are connected directly to the 2,200-volt supply. Resistor type current-limiting fuses are used to protect the bus against possible failure of the control supply transformer.

Ability of the 2,200-volt equipment to perform under severe short-circuit conditions was evidenced during the construction period. A cable splice in a motor circuit had been made up in tight quarters without being properly insulated. Due to an emergency, an attempt was made to start the motor before the circuits had been tested. At the time of the initial operation there was actual metal to metal contact under pressure between two phases. This represents a particularly severe short-circuit condition because no arc voltage drop existed to limit the current. With the conditions as described, the contactor was closed

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1600-1604 53rd Street, North Bergen, N. J.
N.Y.C. Tel.: LOngacre 5-3227—N.J. Tel.: PAlisade 6-2600
HOWARD B. JOHNSON, 53 W. Jackson Blvd., Chicago, Ill., Chicago Representative

MOTOR GENERATOR SETS

1—580-kw., 600 volt, General Electric, Synchronous.
1—200-kw., 250 volt, General Electric, slip ring.
1—100-kw., 250-V., Synchronous.
1— 75-kw., 125-V., Crocker-Wheeler, Synchronous.
2—50 KW, Westinghouse, squirrel cage, 4000 volt Motor.
1— 50-kw., 125-V., G.E., Sq. Cage.
1— 50-kw., 250-V., G.E., Sq. Cage.
1— 35-kw., 125/250-V., General Electric, Sq. Cage.
2— 35-kw., 125 volt, Electric Machy., squirrel cage.
2— 30-kw., 32 volt, ball bearing, squirrel cage.

TURBINES

3—1000-kw., 2300 volt, condensing.
1—500-kw., General Electric, 3 phase, 60 cycle, 480 volt bleeder.
1—300-kw., 3 phase, 60 cycle, 220 volt, General Electric, condensing.
1—250-kw., Westinghouse, 3 phase, 60 cycle, non-condensing
1—200-kw., General Electric, condensing.
2—150-kw., Westinghouse, 125/250 v., non-condens.

TRANSFORMERS

1—15,000-kva., Pittsburgh, 3 phase, 26,000/4150 v.
3—400-kva., Moloney, 13,200-220/440 volts.
4—300-kva., Pittsburgh, 4600/115/230 volts.
4—200-kva., Pittsburgh, 7800/220/110 volts.
3—200-kva., G.E., 4150-230/460 volts.
2—200-kva., General Electric, 2200/220/440 volts.
3—150-kva., Pittsburgh, 6600/440 volts.
3—150-kva., General Electric, 33,000/2300 volts.
18—150-kva., G.E., 3 phase, 4150-120/208 v.
6—100-kva., Wagner, 2200/220-110 volts.
3—75-kva., Pittsburgh, 2400/120 volts.
2—50-kva., General Electric, 2200/220/110 volts.
2—50-kva., Kuhlman, 2200/110-220 volts.
3—37½ kva., General Electric, 2400/240/120 v.
3—25-kva., Paranol cooled, 2200/220/110 volts.
3—25-kva., Westinghouse, 440/220-220/110 volts.

MOTORS—3 PHASE, 60 CYCLE

No.	H.P.	R.P.M.	Volts	Type
1	720	360	440	G.E. Syn.
1	500	450	2300/4000	G.E. Sl. Rg.
1	400	514	440	West. Sl. Rg.
1	350	300	440	G.E. Sl. Rg.
1	350	100	220	G.E. Syn.
2	335	600	2200	G.E. Syn.
1	300	450	440	El. Machy., Syn.
1	250	450	440	G.E. Sl. Rg.

VARIABLE SPEED 230 VOLT MOTORS

H.P.	R.P.M.	Type
1—150	300/900	Westinghouse
"	470/940	G.E.
75	235/950	Burke
35	500/1500	G.E.
30	600/1200	West.
25	300/1200	G.E.
4— 20	400/1200	G.E.
3— 15	300/1200	G.E.

ENGINE SETS

13x15 Skinner Uniflow, 150/300 RPM, engine only.
16x36, Hamilton Corliss, heavy-duty, with 165 KW. 3 phase, 220 volt General Electric Generator.

Complete Line of A.C. and D.C. Motors and Generators

-TRANSFORMERS-

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI, OHIO

"CHICAGO ELECTRIC" Guaranteed Rebuilt

MOTOR-GENERATOR SETS

1500 KW Wtg. 250 v. 3/60/2200 v. syn. 360 RPM.
500 KW GE MPC 600 v. DC 440 v. 720 RPM syn.
500 KW Nat'l. 250 v. DC 4400/2300 v. syn.
400 KW 3-unit 125/250 DC 650 HP syn. 2200/440.
300 KW 3-unit 125/250 v. 4400/2300 v. syn.
300 KW GE 250/375 v. 2200/440 v. induction.

SLIPRING MOTORS 3 Ph., 60 Cy.

2—600 HP G.E. I-M. 1700 RPM. 2300 v.
3—500 HP G.E. I-M. 600 RPM. 2300/440 v.
1—300 HP G.E. MT. 514 RPM. 4000/2200 v.
2—350 HP Elliott Sq. Cage 3450 RPM 2300 v.

SYNCHRONOUS MOTORS

1200 HP Gen. Elec. 2-psed. brg. type ATI, 200 RPM
1000 KVA Westinghouse syn. con. 440 v. 900 RPM.
720 HP Westg. 4100/2300 v. 750 RPM
710 HP GE ATI, 720 RPM 2200/440 v.
650 HP Allis Ch. 2300/440 1200 RPM.

ENGINES

800 KW Skinner-Universal Unaflow engine-gen. GE ATB 3/60/480 v. .8 p.f. 150 RPM.
1000 KW Nordberg twin-Unaflow 1. p.f. 3/60/220.
375 KVA Skinner Univ. Unaflow with GE 440 v. gen. 200 RPM, .8 p.f.

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EBASCO SERVICES INCORPORATED, TWO RECTOR ST., NEW YORK, N. Y.

3—600 ampere, 15,500 volt, 3 pole, Oil Circuit breaker, Westinghouse type B4 Complete.
1—300 ampere, 7500 volt, 4 pole double throw Oil switch.

THE SULLIVAN ELECTRIC CO.
836-838 Reedy Street, Cincinnati, Ohio

WANTED
CONDENSERS
One or Two 25 Cycle Synchronous Condensers of Approximately 5000 KVA Each
SALT RIVER VALLEY WATER USERS' ASSOCIATION
Phoenix, Arizona

and the fuses cleared the short promptly. There were no outward indications that the oil contactor had handled a short circuit and the contactor required no attention to restore service when the splice was reinsulated and the fuse replaced.

440-Volt Equipment

Due to the high capacity of the 440-volt power transformers and their proximity to the load centers it was estimated that, with due allowance for line drop, the short-circuit currents might reach 10,000 r.m.s. amperes at the starter locations.

Since the branch circuits are subjected to no unusual exposures there seemed little likelihood that many severe short circuits would develop during the life of the equipment. For this reason there appeared no justification for the added expense of a starter designed for the full 10,000-amp. short-circuit duty. An economical solution was to use a contactor size selected according to industrial control standards for each of the drives and to provide branch circuit protection based upon the full short-circuit capacity to protect the main supply against communication of a branch circuit failure. Barriers are provided between the starter equipment and the thermal breakers used for branch circuit protection so as to protect the breaker against an exchange of ionized gases in case of a major short circuit. A typical assembly of these starters before installation is shown.

The 440-volt starters are provided with thermal overload protection similar to that described for the 2,200-volt equipment. No current transformers are required since the heater coils are placed directly in the motor circuits. Main motor circuit test jacks are provided for NEMA size 1, 2 and 3 starters.

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EHFA Signs Contracts

Electric Home and Farm Authority has announced that a contract has been closed with the City of Escanaba, Michigan. Contracts have also been closed with the City of Bastrop, Texas; Brenham, Tex., Giddings, Tex.; Houghton County Electric Light Co., Houghton, Mich., and the Iron Range Light & Power Co., Iron River, Mich. Contracts provide that EHFA and the utilities will cooperate in financing the sale of electric appliances for use by consumers located on the utilities' power lines.

Books Received

The Mechanism of the Electric Spark. By Leonard B. Loeb and John M. Meek. Stanford University Press, Stanford University, Calif. 188 pages, illustrated. Price, $3.50.

Comprises three long chapters, one extending Townsend's theory of spark mechanism, another developing the streamer theory of spark discharge, a third devoted to application of the evolved mathematics to the calculation of breakdown. Lightning engineers will find profit in comparing their long-gap conclusions with pattern here set up for gaps of any length, field distribution, electrode geometry, atmospheric density and corona tendency.

Trane Air Conditioning Manual. Published by The Trane Company, LaCrosse, Wis. 376 pages, illustrated. Price, $5.

Revised edition carries added chapter on ducts and fans which is available separately bound at one dollar (50 cents to purchasers of earlier editions of the large manual, latest in 1938).

Code for Electricity Meters. Published by Edison Electric Institute, New York. 128 pages. Price, $2.

ASA Standard C 12–1941 prepared by Bureau of Standards, A.E.I.C. and E.E.I. covers manufacture, acceptance, installation, characteristics, performance and testing of energy, demand, power-factor meters and auxiliary apparatus. Previous edition 1928.

Lightning and Electricity. By WPA-Pennsylvania Writers Project. Published by Albert Whitman & Co., Chicago. 46 pages, illustrated. Price, $0.50.

An elementary science reader for third grades.

The Engineering Index—56th Annual Volume. Published by Engineering Index, Inc., New York. Price, $50.

Contains 26,000 annotations of important articles in current domestic and foreign technical periodicals with 40,000 cross references and an author-index of 19,000 names.

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REA Groups Merge

Consolidation of three REA power groups has been effected at Greenwood, Miss., under the title of the West Mississippi Electric Power Association. It joins the Coahoma Electric Power Association of Clarksdale, Twin County Electric Power Association of Hollandale, and Delta Electric Power Association of Greenwood into a single organization chartered by the State of Mississippi.

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Chicago Deal Approved

Peoples Gas Light & Coke Co. has been authorized by the Illinois Commerce Commission to acquire all the gas properties of the Public Service Co. of Northern Illinois within the corporate limits of the city of Chicago for $3,700,000.

- **Police Radio Transmitters and Receivers.**
- **Broadcast Transmitters.**
- **Concentric Line and Fittings.**
- **High Frequency Antennae.**
- **Special Radio Apparatus to specifications.**

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Model FD-9
FM Monitor

Direct reading of Center Frequency Deviation, with or without Modulation. Single or Dual frequency operation crystal controlled for maximum stability. Adjustable Flasher for Modulation Limit. High Fidelity Audio Monitor Output. 20 KC Maximum Swing Indication. Center Frequency Deviation Range plus or minus 15 KC for general service. Frequency Range 30 to 40 megacyles.

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